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AGRICULTURAL CIRCULAR

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DEPARTMENT OF AGRICULTURE, FIJI.

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CURRENT ISSUE.

THE exigencies of the demands made on the limited scientific staff had for a long time led to the discontinuance of the publication of the *Agricultural Circular*. This official organ of the Department of Agriculture was re-issued in a more extended form last June and since then the publication has been again interrupted.

It is felt that, while awaiting the date of publication, information of seasonal value may become stale, and, on the other hand, work approaching completion may not be quite ready on the due date of publication. It is expected that by issuing this *Agricultural Circular*, in numerical order and independently of dates, as and whenever occasion demands, information will reach the planter in quicker time.

ERRATUM.

IN the last issue of the *Agricultural Circular*, Vol. 5, No. 1, a Paper on "Breeding Dairy Cattle," attributed to Mr. E. F. Simmons, should have been credited to Mr. J. Fred. Simmonds, lately Manager of the Fiji Pastoral Company's Dairy Farm at Navua.

GOVERNMENT CHEMIST.

THE important office, long left vacant, of Government Chemist and Analyst has at last been filled by the appointment of Mr. Colin L. Southall, B.Sc., A.I.C., who arrived in the Colony on the 4th February and started on his official duties on the 14th February.

The Health and the Police Departments will also have a call on the Chemist and Analyst who, besides co-operating with other technical officers of this Department when required, will also find an ample field awaiting chemical research work.

DEPARTMENT OF AGRICULTURE, RABAUL.

FROM the Department of Agriculture, Rabaul, Territory of New Guinea, the favour is acknowledged of a series of leaflets dealing with cotton, coconut, cacao, and maize. These leaflets which convey in a condensed form, information on plantation work and disease of crops add a valuable link to the chain now connecting every tropical country of note and are therefore welcome not only to the local residents but to students and planters far away.

An Entomologist is expected to soon strengthen the staff of the Department and interchange of information and of beneficial insects may therefore be looked forward to in the near future.

GRAMMAR SCHOOL TEST PLOTS.

The Provincial and also the Mission schools have from their inception been dependent on school-grown ground crops for their maintenance. Evidence is not lacking wherever such schools are established of the useful training these boys receive to fit them for the responsibility of being able to depend on their own efforts for raising their own food stuff.

Amongst other useful innovations introduced at the Boys' Grammar School by the Head Master, Mr. D. McCormick, is one calculated to arouse in the students an interest in the cultivation of the soil. The principles underlying soil production are imparted in the class rooms while field plot demonstrations are carried out on the school ground in raising crops of economic value. In order to familiarise the boys with the appearance and the characteristics of field pests and friends, of seeds, grasses and plants a nucleus has been started of an Agricultural Museum.

An understanding has been come to with the Agricultural Department whereby any new plant or grass intended to cultivate under observation may be tested on the School ground before measures are taken for more extensive field trials.

SOIL EROSION.

In Fiji more particularly where heavy tropical rains fall at times the question of soil erosion has to be faced.

The physiographical features of the country presents a broken mass of hills more or less steep, rising from undulating spurs bordering valley land through which run rapid streams.

The annual rainfall varies from moderate to heavy; it frequently comes down in tropical downpours running down the slopes, collected and conducted into larger water-courses acting as large arterial drains. This water carries away large quantities of soil. In places the friable surface earth overlies a stiffer volcanic tuff presenting a floor over which the water runs more or less rapidly as these slopes are cleared of the forest growth and are loosened by cultivation. Unless checked in its course, this running water starts an erosion which gradually becomes more pronounced until in time earth-wash results which is loss of capital soil value.

This occurs more noticeably where tenant farmers, mostly Indian with a yearly tenancy, are in occupation.

In order to preserve this great asset of the country, a time will come when tenants will have to comply with certain requirements, such as: (*a*) Dig contour drains; (*b*) provide silt pits; (*c*) plant contour hedges of leguminous plants along roads and foot-paths; (*d*) instead of a bare fallow, after a crop has been removed from sloping ground, sow crops of leguminous cover plants. At present when lands are opened up for planting, how often are those requirements observed ?

One fact is evident, and that is unless indiscriminate denudation of the land is regulated and so long as the yearly tenant is given a free rein to do as he pleases the country will in some places lose its greatest asset—the soil.

INSECTIVOROUS BIRDS.

The Colonial Sugar Refining Company, Limited, submitted last year a list of certain birds, lizards, parasitic and predaceous insects with an application for a permit to introduce, the purpose of this proposed introduction

being in the first place that of controlling the sugar-cane pests on the plantations of Fiji.

As the birds, lizards, and insects named are all essentially insectivorous, the permit was issued, and after having secured the concurrence of the Commonwealth and State authorities in Australia, steps were taken to carry out the intention.

As a result a first instalment has been landed by the Colonial Sugar Refining Company's s.s. "Rona" when some Tawny Frogmouths (*Podargus strigoides*), popularly known as More-Pork, were introduced. The Frogmouths have travelled well from Australia and were healthy on arrival. They were sent to Labasa for liberation.

This useful nocturnal bird, which has a wide range over Tasmania and Australia, feeds upon phasmids (stick insect), mantis, leaf grasshoppers, and cicadas, also on mice. Its acclimatisation in Fiji should benefit coconut planters and others as well as sugar planters.

COMBATING MOSQUITOES.

In a letter received from Mr. A. M. Lea, Entomologist, on a mission in connection with the introduction of parasites for the *Levuana* moth of the coconut, the following reference is made to methods of control of the malarial mosquito in the Federated Malay States:—

"I thought we would be troubled by mosquitoes, but I doubt if we have seen half a dozen in any day and often have not seen any for the whole day. We often notice the reek of oil on water, and hollows in trees where water might lodge and breed larvæ are often filled with concrete. Thousands of dollars are being spent on anti-mosquito work. Water in the paddy fields, irrigation ditches and roadside cuttings appear to swarm with small fish which no doubt keep down the wrigglers. It is amusing to see numerous youngsters fishing in two or three inches of water in the paddy, all with short bamboo rods; in the irrigation drains, rods that are long enough to reach beyond the opposite banks are often used."

RICE EXPERIMENTAL PLOTS.

The importance of rice cultivation to Fiji is such that steps are being taken to maintain a supply of pure seed to growers and to regulate the introduction and testing under the control of the Department of Agriculture of selected varieties noted for their yield and quality.

For that purpose a commencement has been made on a piece of flat, irrigable land, along the Rewa Road, and fifteen acres have been selected and prepared for the purpose.

Samples of the three Fiji-grown rice cultivated compare favourably with imported, while "Motka," the local table rice, more particularly, is considered superior. At least such has been the opinion expressed by buyers in other islands of the Pacific and New Zealand, where a promising export business was being built up, until interrupted by the crop shortage of last season.

An examination of the rice fields, however, shows that for lack of care in observing methods of clean cultivation and of rotation of crops, the several kinds are showing a tendency to becoming mixed.

The object of the experimental plots is to insure, by means of plant selection in the field, an increase in the yield of pure varieties. For that

purpose the plots which were sown with properly picked seed will be carefully gone over and all plants showing divergency from the set type will be eliminated. At the same time, plants showing special quality will be marked and harvested separately and cultivated under observation. Two local varieties are thus being grown, namely: "Motka," a table rice, and another one, name unknown, also of great merit.

Selection of seeds of the other local varieties: "Chetwa," the kind favoured by the Chinese, and "Patna," mainly consumed by the Indian population, will be made from fields grown by Indians along the Rewa, as the ground is required for four wet-land varieties of rice from seed imported from the Philippines, viz., Calibo III, Minalit, Magcumpol, and Macantago.

The purpose of the nursery is simply to test, discard or distribute, as the case may be, varieties imported under the most careful conditions and of improving the local rice which have become mixed and threaten to depreciate for lack of proper attention.

The total cost this season of the experimental plots is estimated not to exceed £150, less the value of seed to be harvested, representing a small charge which Mr. Tarby, the Manager of the Government Rice Mill, will make to cover cost of handling.

PRESERVING TROPICAL FRUITS.

At the recent session of the Pan-Pacific Food Conservation Conference, Dr. P. J. S. Cramer of Buitenzorg, Java, referred to the success he had attained in shipping tropical fruit to temperate zone markets.

The method consists simply in dipping the fruit in rubber latex, allowing the rubber film to harden, and then shipping the fruit as ordinary freight without cold storage.

According to the *Honolulu Advertiser*, Dr. Cramer has shipped fresh strawberries treated in this way, the fruit holding its flavour, form, aroma, and practically the same stage of ripeness from ten to fourteen days. He has shipped latex-dipped ripe mangos, and the mangosteen, which is considered the most delicate of all tropical fruits, from Buitenzorg to L'Acclimatisation Société in Paris, where the members proclaimed their arrival in perfect condition.

In the course of his experiments this scientist took green bananas and dipped them half their length in the rubber latex. The untreated half of the fruit ripened while the "rubberized" half of the banana remained green.

Rubber latex is cheap in most tropical countries. It can be preserved almost indefinitely by adding ammonium sulphate, which retards coagulation.

Its utilisation as a preservative in the shipment of tropical fruits to temperate zone markets opens up fascinating possibilities for the tropic fruit farmer. The thin film of rubber on the surface of the fresh fruit strips off as easily as a glove from the fingers, allowing the normal ripening process to continue.

The theory of the new method is that the ripening of fruits is an oxidation process depending on free absorption of oxygen and the exhalation of carbon dioxide. The rubber latex coagulates into an air-tight envelope which checks both. It also prevents the growth of mould spores and the bacteria of fermentation so that the ripening fruit is held in a sort of trance, without any change whatever.

SAMOAN COPRA.

A SAMPLE of machine-dried copra, received through the courtesy of the Director of Agriculture, Samoa, reached this Department a few months ago and on being submitted to shippers for an expression of their opinion drew very favourable remarks as given below.

Dehydration, it was remarked, was in the experimental stage in the island and the authorities were interested in obtaining the opinion of the trade as regards the merits of the sample submitted.

As soon as the Government Analyst has been able to deal with an accumulation of pressing work requiring attention, he will be asked to make a comparative test of this improved Samoan copra with the product of local plantation and also native-dried copra, and test bulk samples for moisture, oil, and free fatty acid.

With freight at £4 a ton there is no profit in shipping an unnecessary proportion of water, fatty acids, and dessicated green coconut meal, instead of good grade copra.

The opinion of wholesale exporters is expressed as follows regarding the Samoan copra submitted to leading Fiji firms.

The Manager of Burns, Philp (South Sea), Ltd., on being consulted expressed his opinion as follows:—

With regard to value we should say, judging by appearance only, it is worth 25s. to 30s. per ton more than average Fiji plantation, and 30s. to 35s. per ton more than standard Fiji sun-dried.

Messrs. Morris, Hedstrom, Ltd., stated:—

The sample is undoubtedly one of a very good grade of copra and if copra of this grade could be regularly shipped to Europe in sufficient quantity it would eventually obtain a higher price than Fiji f.a.q. or Fiji plantation, but the process of educating buyers to a new grade of Fiji copra might take considerable time.

The head of the firm A. M. Brodziak, Ltd., stated:—

There is no doubt that the copra is superior to our ordinary plantation and South Sea copra shipped from Fiji. I would estimate the Samoan sample would bring at least 30s. per ton more than our plantation copra and if dried properly the difference would be greater.

The fact is now being brought home more clearly to the mind of observant plantation owners and managers that artificial drying offers advantages over sun-drying, when the sun is screened by a high degree of air humidity and by heavy wet weather.

A few kilns have recently been erected and introduced, and the merits of the application of dehydration method to the drying of copra is gradually making converts.

SOUR PASPALUM GRASS.

IF one grass more than any other has led to a good deal of controversy regarding the name it goes under in the islands, it is the " Thurston Grass." Some have it that the true grass of that name is the *Paspalum conjugatum*, which is widespread over the wet part of the islands, others maintain that the name attaches to a more useful grass, viz., *Panicum distachium*, which is more prevalent in the dry zone and is also a more nutritious and a more palatable grass. This confusion of names is regrettable.

Both these grasses are referred to in the chapter of " Grasses and Pastures " in the last issue of the *Agricultural Circular*, Vol. V, No. 1.

The " Thurston Grass " of the wet zone (*Paspalum conjugatum*) is widely spread over the tropics and goes under the name of " Barbados Sour Grass " in Ceylon, " Bitter or Buffalo Grass " in the Philippines, " Hilo Grass " in

Hawaii, " Sour or Yellow Grass " in Queensland. Stock eat it under compulsion when better grass to graze on is absent.

The problem of how best to eradicate it is one which occupies the mind wherever it is growing.

In Hawaii, Hilo grass is a serious obstacle to reafforestation as it spreads over the ground and chokes the seedlings out; growing even under the shade of trees, it interferes with growth from the time the young trees are planted.

The only practical way of subjugating it has been by fighting it with a taller or a more aggressive smother grass, such as Para, Kikuyu, Carpet grass or by sowing a rampant and vigorous leguminous crop such as Mauritius Bean (*Stizolobium aterrimum*), the crop usually planted for green manuring in Fiji.

As previously mentioned in the article on " Grasses and Pastures " a top dressing of phosphate manure, preferably of basic superphosphate, corrects its sour or bitter taste and makes it sufficiently palatable to draw stock who then eat it freely.

The sour or bitter Paspalum, as it should be named, spreads more readily in the wet zone, being replaced by *Panicum distachium*, a more nutritious and a better grass, in the dry zone. As there is so much confusion about the grass which should be called " Thurston Grass," a name restricted to Fiji, it seems that another name such as " sour " or " bitter " paspalum would be more appropriate.

WATER HYACINTH.

This water weed, *Eichornia crassipes*, which is infesting the lower reaches of several of the rivers, is one more instance of thoughtless and regrettable introduction into Fijian waters of a most troublesome water weed.

In Queensland it has long been proved a serious obstruction on the waterways of sluggish rivers and a great deal of money has been spent in trying to keep it within bounds.

In East Bengal, the granary of the province, water hyacinth has spread with amazing rapidity within recent years and has invaded to a large extent paddy lands and made them unproductive.

The plant, which possesses a beautiful blue flower, propagates in the water by seeds which fall between the leaves and germinate, also by stolons or runners, and a single plant can in a few months cover a big patch of water either shallow or deep.

The trouble seems to be getting more pronounced, and unless tackled energetically will become costly to control. Where it covers the surface of the water thickly, it becomes entangled in the screw of launches and blocks traffic. Some of the blind creeks along the Rewa are already covered and it is a common sight to notice afloat bundles of Para grass and of water hyacinths drifting up and down the river according to the tide. A fruitless effort was made some years ago and resulted in the weed being spread more extensively, in the endeavour to destroy it, when it was torn from the banks of the river and towed outside and dumped outside the mouth into the sea, the rising tide taking much of it back again.

Cattle eat it readily on shore, so that wherever practicable they would dispose of it if dragged out of the water and left high and dry on the banks, where it would be eaten or perish and leave a compost rich in potash.

Various means have been tried to destroy it in the water, mainly by spraying with poisonous solutions such as sodium arsenate, copper sulphate or blue stone; these give promising indications of being efficacious at first, but

often prove inadequate in killing the plant throughout. A poisonous solution moves upwards and only under special conditions downwards, so that there is at first an apparent wilting of the floating top, but the submerged roots remain active and throw new growth.

Water hyacinth has been proclaimed a noxious weed by Order in Council dated 11th January, 1923, and steps should therefore be taken for its eradication, at least for that part of the rivers above tidal water. Its transportation, should be forbidden and once the banks have been cleaned of the weed the responsibility should be placed on the owners or occupiers to keep their water-front free. In a country like Fiji, where rice growing is capable of vast extension, the paddy land is worthy of protection.

NOXIOUS WEEDS.

THE spread of the prickly Acacia (*A. farnesiana*) is developing into a problem in that portion of the North Coast having Ellington as a centre.

Cattle are the chief means of spreading the plant as they eat the pod without being able to crush the hard seeds within.

Nothing but careful eradication with the grub hoe or pulling out after wet weather by horse power with block and tackle, if practicable, will get rid of it, and even then the suckers will require timely attention subsequently.

The shrubs when growing thickly form impenetrable thickets. The spines break easily into the legs of riders or the hide of the stock and often cause festering sores. The pest spreads on good land and destroys its value for stock raising.

The majority of settlers welcome the inclusion of that troublesome, prickly bush in the list of proclaimed weeds.

THE AGRICULTURAL SCHOOL, NAVUSO.

ON Thursday, the 12th March, the Acting Governor, accompanied by the Acting Superintendent of Agriculture, the Acting Superintendent of Schools, and the District Commissioner, Rewa, paid a visit to the Methodist Mission Agricultural School at Navuso. His Excellency was met on landing by the Chairman of the Methodist Mission, the Committee of Management of the School, and Mr. B. C. Meek, Agricultural Instructor.

Thirty-five Fijian students and three Indians are at present receiving instruction at the school.

Buildings, consisting of the Instructor's house, a school-room, labour lines adapted for Indian students, stables, milking stalls, creamery, &c., are sufficient for present purposes and appeared to be suitable.

Crops of sugar-cane (in the planting of which the school is advised by the Colonial Sugar Refining Company), maize, kumalas, rice, tapioca, and food-stuffs for the students are being planted. Twenty-two cows are being milked by Fijians, and the cream sold to the neighbouring factory. Students are being instructed in proper methods of raising and looking after stock. A system whereby the students gain a percentage of the sale of produce for themselves has been adopted by the Mission. Recently kumalas were shipped from the school to Canada, the white variety finding a ready market.

Ploughing by the students was proceeding actively. Great difficulty is being experienced in eliminating para grass from the land to be prepared for crops. The whole area is full of it, and it is to be regretted that it has

not been possible, with funds available, to purchase or hire a suitable tractor for the heavy ploughing initially necessary on the land.

The school is yet in its infancy. It is the intention of the Mission to develop on scientific lines and to keep detailed statistics of areas planted, work involved, and its estimated value, plants and their variety per acre, weight of crop, times of planting and reaping, rainfall, &c. It is highly important that such statistics should be systematically kept and information be readily available. As time progresses, experiments will be made in various directions—with ground nuts, bananas, pineapples, &c., and it is hoped with Indian foodstuffs, such as dhal, mustard seed, &c.

The beginning made by the Methodist Mission is deserving of full support. The farm, when land has been broken in and freed from Para grass, should steadily improve, and the keeping of statistical information regarding crops and stock, the introduction of scientific methods of cultivation and care of stock should prove to be valuable training for Fijian and Indian youths in a direction much needed throughout the Colony. Agriculture provides a fine, healthy, manly profession, and His Excellency was glad to learn from Mr. Meek that the students seemed happy and interested in their work.

It was disappointment to His Excellency to learn that Indians were not offering more freely for instruction at the school. There can be few finer occupations for men of any race than agriculture, and methods of agriculture cannot do otherwise than improve with proper instruction. It is hoped that Indian numbers at the school will increase.

The school is at present without a rain-gauge, which the Acting Superintendent of Agriculture fortunately is in a position to supply.

The Acting Governor noticed with some concern a patch of Elephant grass which had been obtained from neighbouring planters who had introduced it from Australia and was being grown experimentally on the farm. It was stated to have excellent qualities as a fodder grass. His Excellency's knowledge of it in West Africa was that it was there a curse, and in some localities vast areas are covered with it, almost impenetrable to the human being and the haunt of big game. The cane grows to a height of some 14 feet, with the stiffness almost of a light bamboo, when mature. A telegram has been despatched to the Gold Coast asking the opinion of the Director of Agriculture, who has knowledge of Fiji, regarding its introduction into Fiji. Fiji has already so many weed-curses, that no one wishes to add another and, pending full consideration of the question, it is hoped planters who have experimented with the grass will use every precaution in guarding against its indiscriminate spread.

His Excellency wishes the school every success. He trusts that this important branch of instruction will receive every encouragement from Fijians and Indians, and that as time goes on the school will progress on model lines and will eventually benefit the Colony by disseminating amongst its people improved methods of agriculture.

GRASS SEEDS.

Occasionally the Department of Agriculture receives small supplies of grass seed for trial, packets of which sent out to graziers have met with variable success, according to the care and attention given and to the season.

In acknowledging receipt of some of these seeds, Mr. G. C. Foulis of Wainivoce on the road from Tavua to Nadarivatu reports having in addition ten varieties he ordered from Australia, besides some others sent him for trial by Messrs. Yates & Co., Ltd., Sydney.

The trials are carried out on a small plot of good black soil on the coast, from which a crop of Mauritius bean was harvested in August.

Mr. Foulis finds that Kikuyu grass does very well on that land and he intends putting under this grass next April, at the end of the rainy season, a four acre plot, as the grass has given most satisfactory results, being a rapid grower and readily eaten by all stock. It is a grass worth taking trouble to get it established.* At a later date Mr. Foulis remarks:—

I cannot speak too highly of my small plot of that grass which has been established for two years and has stood very hard feeding by sheep in the dry season of the year. It is eagerly sought after by all stock and appears to grow best during the winter months when other grasses are more or less at a standstill. It is in my opinion a grass worth taking a little trouble to establish as it is a heavy cropper and a good fodder and I have got best results by planting in drills 3 feet apart and weeding about once.

At a later date (late in November), Mr. Foulis remarking on some Solomon Island clover plants (*Desmodium multiflorum*) handed to him by the District Inspector of Plantations, Mr. J. White, reports that when the plant came to hand, it had runners five inches long, whereas now, planted in soil in which the smaller *Desmodium* clover grows, it has in three months sent out seven new runners measuring approximately 15 inches each. Several of these have from nineteen to twenty-one seed pods containing five seeds and more.

According to the same observer, there is a small plot of Crested Dogstail, also of Cocksfoot, growing at Nadarivatu, both of which look well and appear to have established themselves. This is important in establishing the fact that these grasses can be grown, at least on the mountains.

DESMODIUMS.

TROPICAL CLOVERS.

Unlike California and Australia where clean cultivation is essential for the conservation of soil moisture, Fiji with a more humid climate and with a heavier rainfall favours the continuous growth of perennial herbage or plants. Thus nature protects with the aid of a cover crop the rolling downs and steep escarpments of mountain side from soil erosion by storm water running down the slopes. For that purpose, creeping or prostrate plants are preferable to erect plants, round the stems of which surface water often cuts channels, unless they are thickly planted.

Some of these creeping plants although hardy and easy spreading and also valuable as soil renovators, present objectionable features, such for instance as the sentitive plant, which on account of its small thorns on its creeping stems, hurt the feet of labourers and of live-stock. Leguminous plants, on account of the property they possess of gaining nitrogen from the air, offer an additional advantage, but the choice is often restricted by climatic conditions or by soil preference. Permanent plants under island conditions are preferable to annuals.

In Fiji a group of indigenous leguminous plants stand out amongst others, viz.: the *Desmodiums* of which there are several species which flourish and spread in the tropics where they are known under such names as "Florida Beggar Weed," "Tick Trefoil," &c. Amongst those more generally noticed are:—

Desmodium triflorum D.C. Perennial, prostrate, forming a flat mat on the ground, leaves of clover shape, leaflets quarter to three-eighths inch long,

* *Vide* "Kikuyu" in this issue.

flowers bright purple, very small, usually three together on a small stalk. The pod is jointed, with two to four seeds. Mixes well with grass in open country. When top dressed with basic phosphate supplies an abundance of nutritious food.

Desmodium heterophyllum D.C.—Also a prostrate plant but with stronger stems and larger leaves, forming a more open mat. The terminal leaflet is larger than the other two, hence the name given to the species.

The leaflets are half to one inch long and usually have a pale or glaucous area along the middle. The flowers are also purple, small, two or four together on a slender stalk. The pods have three to six joints. The plant grows well among grass.

Desmodium heterocarpum D.C.—A larger plant than the previous two. The seed pods are conspicuously clustered in a mass at the top of the stem. The plant is perennial, sub-erect, rooting at the nodes when the stems curve upwards. The pods are about an inch long, usually five or seven jointed.

Desmodium polycarpum D.C.—A few seeds brought from the Solomons in April by Mr. H. W. Simmonds were sown in a box by Mr. Ching at the Municipal Nursery and seedlings distributed brought the following acknowledgement: Mr. J. Fred. Simmonds, Manager for the Fiji Pastoral Company, Navua, writing regarding the prospects of this Solomon Island trefoil remarks: "Its growth is astounding and made under trying conditions. Numerous joints in the branches or runners which cover an area of four feet across, six months from seeding, are rooting. If sufficient seed can be procured no pasture should be without; it is certainly a bright spot in the future pastures of Fiji."

Mr. G. C. Foulis, grazier, Wainivoce, Tavua, writing also at the end of the year says: "I am enclosing a few seeds of the Solomon Island clover sent me a few months ago. Six seed stalks in all matured on this particular plant and at present six more are out in flower. The plant has made good growth and seems quite at home and I am carefully planting every seed that matures, hoping that I might establish the variety."

Seeds sown in Suva in May grow vigorous plants which were blossoming and seeding at the end of the year. The runners pinned down to the ground root at the joints and runners cut a few inches long and placed in the ground also root easily.

The fodder has every appearance of being an acquisition to the planters of Fiji. It will be tested at a later date for palatability and also analysed and compared with well-known plants of the clover family. The other kinds of *Desmodiums* referred to are already widely distributed in the islands and are readily eaten by stock.

RUSSELL RIVER GRASS.

Some seeds of Russell River Grass were introduced from Queensland (*Paspalum paniculatum* or *P. galmarra*). In the *Queensland Agricultural Journal*, a correspondent at Atherton, says:—

When on a farm at Atherton I had a lot of it on my place and used to curse it pretty freely on account of the speed with which it covered the ground. It is a fairly useful feed, especially as a change of diet just after a grass fire while it is young and sweet. It soon becomes very course and stock will not look at it. Horses though not eating it, keep fit through eating the seed heads. As a grass it is a very prolific seed bearer. It will never become a permanent pest in ploughable land as one turning over settles it.

KIKUYU GRASS.

(*Pennisetum clandestinum* or *longstylum*.)

PATCHES of this valuable perennial grass are seen at several places, growing with much promise of success in Fiji and the opinion of a grazier is reported on the notes on " Grass Seeds " in this issue. On going to press the experience of another grazier from the Sigatoka Valley, Mr. R. B. Howard, is also favourably expressed in the *Fiji Times and Herald*.

It is essentially a pasture grass for land which is not likely to be used for crops or for plantation work, as once introduced into a field it is most difficult to eradicate.

When this is understood and remembered nothing but good can be said in favour of the grass. It belongs to a notable family of African Grass which has furnished several valuable members, notably: Elephant Grass (*Pennisetum purpureum*) and its near relatives Merker Grass (*P. merkeri*) and Pearl Millet or Bajri (*P. spicatum*). The first one under humid tropical conditions such as obtain on the Gold Coast and the Ashantis is said to be of doubtful value as it spreads over good land and smothers the smaller grasses. It is referred to further in this issue.

Kikuyu is easily and cheaply established and thoroughly permanent, it grows on poor loose, sandy soil, but of course best on moist loam. It is reported to flourish in all latitudes in Australia and stands a wide range of temperatures from the tropical north to the southern shores. It resists drought, floods, cold, grows in much water-logged land, deriving much of its nourishment from the air.

The grass does not seed readily in cool climates and is therefore propagated by roots or preferably by cuttings, as roots may carry nematodes and disease germs.

As it keeps green while other grasses turn brown and dry, it makes a good fire break. Kikuyu supplies large quantities of nutritius feed and is palatable to all stock. The aggressive manner with which it behaves towards other crops on cultivated land becomes a quality as a smother grass of bracken and on weedy land. It should give a good account of itself, mixed with Paspalum or with Guinea grass on slopes overrun by Köster's curse.

GRASSES FOR THE SIGATOKA VALLEY.

Mr. Richard B. Howard of Rasikulu, Nadroga, reports that the seeds of *Paspalum galmarra* and of Mitchell grass sent to him have both germinated well.

The *P. galmarra* is growing vigorously and gives promise of doing remarkably well along the Sigatoka Valley.

" The Mitchell grass, " says Mr. Howard, " appears to me to be of the variety known in Western Queensland as Giant Mitchell or Old Man Mitchell. (The seeds sent were those of *Astrebla triticoides* or wheat-eared Mitchell grass). Contrary to my expectations this grass is showing good growth and also gives promise of becoming valuable as a pasture grass."

ELEPHANT GRASS.

FROM information culled from the *Kew Bulletin*, 1912, this grass, also called Napier grass (*Pennisetum purpureum*), extends from Sierra Leone on the Gold Coast to Rhodesia and Biera, right across the moister zone of Africa.

It occurs along watercourses and in marshy depressions but not in stagnant water, it also invades the bush and forests, where open spaces afford sufficient light. Under favourable conditions it forms extensive reed jungles, as in the delta of the Zambesi. In rich marshland it attains a height of 21 ft., while on drier soil it only grows 6 ft. high. The stems are utilised by the natives for making fences.

A reference is made in this issue of the luxuriant growth of this smothering grass under moist tropical conditions. *The Fiji Times and Herald* sounds a note of warning about the risk of introducing this grass:—

It is of a coarse bamboo sort in structure if allowed to grow wild, and in such a climate as ours and under conditions which are so common in Fiji of neglected areas, this grass would grow into a useless jungle, such as is common in West Africa. When short and young, stock like it, but if allowed to grow high and wild, the edible tops are above the reach of cattle and so the growth cannot be eaten down or even kept in check. The danger of its spreading and growing into a pest much more than counterbalances any good it offers as a fodder. There are many better and more valuable fodder grasses and plants than elephant grass.

In connection with the use of elephant grass on some agricultural and pastoral holdings in Fiji, His Excellency the Acting Governor, who has had experience of the jungle-like growth of this grass in West Africa, cabled inquiries to the Governor of the Gold Coast at Accra.

A cabled reply has been received, and we have to thank His Excellency for a copy of it, as it is very important and very interesting to all landowners.

The following is the text of the telegram:—

> " March 18, 1925.—Your telegram 9th March, *Pennisetum purpureum.*—Knowles recommends great caution in use of it in wet zone of Fiji where rapid coarse growth is likely. In dry zone if it became acclimatised and escaped cultivation it would probably replace reeds and coarse grass with little gain from grazing standpoint."

Mr. C. H. Knowles, B.Sc., was, for a number of years, Superintendent of Agriculture in Fiji, and now occupies a somewhat similar position in the Gold Coast Colony. The Government looks upon the introduction of the grass as a very serious matter, and the whole question will receive early consideration by the Executive Council.

DAIRYING BY NATIVES.

The District Commissioner, Colo East, in a report dated 15th February, 1925, states:—

Dairying has been successfully established in the district, and although it is at present confined to a mere handful of European settlers, I place it first under this head, because I think there are great possibilities before the district in the industry. The ban on Indian and Fijian cream has now been lifted (though I understand that they will not be allowed to become shareholders) to the Rewa Co-operative Dairy, and as a result of this, and of wise propaganda by some of the local Europeans, two natives and several Indians have bought separators. The two natives are starting on by no means a small scale, as if they go about it in the right way, and can learn to look after their cattle, their example may lead to great things. It remains to be seen, of course, how far the native—who, I believe, is a conservative individual—can adjust himself to so entirely different a proposition from banana growing. The district is eminently suited to dairying, and if it can be made part and parcel of the home life of the Fijian, he will be assured of a certain and steady income.

CARPET GRASS (*AXONOPUS COMPRESSUS*).

Attention is called in the December issue of the *Malayan Agricultural Journal* by the Department's agriculturists to a grass which may prove a great value to stock owners in Fiji, *i.e.*, Carpet Grass (*Axonopus compressus*, from *Axon* and *pous* a foot).

The grass is of tropical origin, a native of the West Indies, and is now distributed under the name of Louisiana grass throughout the southern United States and from Mexico southward to Argentina and Chile, where it is considered a most valuable grass for permanent pastures on the sandy coastal soils. It differs but slightly in appearance from *Paspalum plata-*

caule, another West Indian plant, although from an agronomical standpoint said to be superior.*

Marked success has followed the introduction of the grass into Malaya, where it is found to readily establish itself by natural seeding and by propagation from runners. It has shown no signs of becoming a troublesome weed but on the contrary is considered a valuable general utility grass.

To establish the grass, cut down useless shrubs and ringbark trees of no value, burn over the area, scatter seed at the rate of 5 or 6 pounds per acre or scatter mown Carpet grass with mature seed; stock heavily to keep down all bunches of tall grasses and shrubs, and a solid Carpet grass sod will cover the land.

It quickly covers bare ground and stands heavy grazing and trampling. On lawns and golf links it offers great possibilities, covering the land almost to the exclusion of all other grasses and weeds and appears to hold its own against the objectionable "Lovegrass" (*Chrysopogon aciculatus*) or even the sensitive plant (*Mimosa pudica*).

It favours light land such as sandy lawns and lateric loams with moisture near the surface. It should be worth testing on the rolling downs of the Bua province, wherever moisture conditions are favourable.

Steps are being taken by this Department to introduce some seeds and test this promising grass which is closely allied to one known as Cockatoo grass in North Queensland (*A. semialatus* or half-winged *Axonopus*) and which is said to furnish the principal food of white cockatoos. It is spoken of as an excellent pasture grass, producing large amount of leafy bottom, although the hard cane-like stems are refused by stock.

ANALYSIS OF GRASSES.

THE knowledge of the value of the chief grasses grown in Fiji from a feeding standpoint is one that possesses particular interest to the stock-owner and above all to the dairy farmer. Prominent amongst these grasses are *Paspalum dilatatum*, Guinea Grass, and Para or Mauritius Grass (*Panicum muticum* or *P. barbinode*).

The following analysis are by Mr. G. R. Patten, Analyst, Agricultural Laboratory, Queensland:—

Constituent.	*Paspalum dilatatum*, young crop.		*Paspalum dilatatum*, old crop.		Guinea Grass.		Para Grass.	
	Green.	Dry.	Green.	Dry.	Green.	Dry.	Green.	Dry.
	%	%	%	%	%	%	%	%
Moisture	74·400	..	66·731	..	78·450	..	75·330	..
Dry substance	25·600	..	33·369	..	21·550	..	24·670	..
Crude fibre	7·680	30·00	10·167	30·560	8·132	37·736	8·270	33·525
Nitrogen	·372	1·45	·169	·509	·238	..	·204	·825
" × 6·25 to proteids	2·329	9·100	1·056	3·181	1·487	6·925	1·275	5·156
Asparagine	·350	1·371	·150	·455	·310	1·451	·037	·151
Ether extract	·788	3·080	1·550	4·660	·707	3·280	·487	1·975
Carbodrydrates (less fibre.)	12·790	49·961	17·814	53·547	8·918	41·385	12·609	51·122
Total ash	2·070	8·088	2·704	8·128	2·474	11·480	2·036	8·253
Nutritive value	..	..	22·357	67·213	..	..	14·979	60·721
Nutritive ratio	..	..	1:20	1:20	..	..	1:10·8	1:10·8

* Another Carpet Grass (*Paspalum compressum*), widely distributed in Fiji, so closely resembles the description of the American congener that steps are being taken to have the two compared. Reference was made to the Fijian Carpet Grass in the notes on "Grasses and Pastures" in the last issue of the *Agricultural Circular*.—Editor.

BUTTER FAT AVERAGE.

No data are available giving the average production of butter fat, per cow, during the period of lactation in Fiji. The only record procurable is that of the Sailors and Soldiers Dairy Settlement at Tailevu.

These figures show that the average per cow milked in 1923 was 173 lb, and in 1924 was 181 lb butter fat. This is 6 lb below the annual butter fat per cow in 1921–1922 in New Zealand and constiutes a promising performance. With the culling and the grading up of the herds of cows, the use of pure bred sires from high test cows, and with better feeding and management, a substantial improvement may reasonably be expected.

New Zealand had 1,130,000 dairy cows in 1921–1922. This total number averaged 168 lb butter fat each for the year.

It is estimated 10 per cent. fail to become milkers, therefore the average New Zealand dairy cow yields about 187 lb butter fat yearly. Butter fat was paid then 1s. 6d. per lb and the price varies with the fluctuations of the market.

The average of 80,000 milk-tested during the period was 245 lb butter fat and there were quite a number of cows which were equal to those tested, therefore there must be a great many duffers which are not paying cows. This means that these 245 lb cows less 187 gave 58 lb more butter fat at 1s. 6d. or £4 7s. over the average for the country.

With an organised system of herd testing and weeding out, the average yield of butter fat per cow has since been substantially raised.

DAIRY COW'S RATION.

By A. Despeissis, M.R.A.C., Acting Superintendent of Agriculture.

Any stock owner realises that no one kind of fodder fed alone can be regarded as a standard daily ration for all classes of cattle.

The growing animal and the dairy cow for instance require a narrower balanced ration; that in which the proportion of flesh formers to heat producers is closer, than do mature store cattle.

For instance, the analysis given elsewhere in this issue of the leading grasses grown on stock farms in Fiji: Paspalum, Guinea Grass, and Para Grass, show a ratio of protein to carbohydrate of 1 to 8, 1 to 6·4, and 1 to 10 respectively. In the case of the dairy cow in milk, it is recognised that a balanced ration of 1 to 6 is conducive to the best economic result.

From experience it is found that the standard daily ration of a cow weighing 1,000 lb in full milk—such a cow would be a large size cow like a Friesian or a Shorthorn and not a lighter beast such as an Ayrshire or a Channel Island cow—should consist of: dry matter 25 lb including protein, 2½ lb; carbohydrates, 15 lb; with a nutritive ratio therefore of 1 to 6.

Taking the average of the three grasses named in protein and in carbohydrates as being respectively Paspalum dilatatum, 1·7 and 15; Guinea grass, 1·4 and 9; Para grass, 1·27 and 12·60. It is seen that a large size cow in milk and eating 100 lb of either of the three grasses named a day would be short ¾ lb of protein in the case of the first; 1 lb in the case of the second; and 1¼ lb in the case of Para grass.

To satisfy the proper functioning of her organisation, she requires in protein as part of her daily ration a larger quantity of grass, viz., 140 lb, 178½ lb, and 190½ lb; as regards carbohydrates, she would require of the above

grasses to supply the 15 lb required: 100 lb, 166 lb, and 119 lb respectively.

It should be said incidentally that in Fiji where Para grass and Guinea grass seed freely, the quantity of grass required would be less during the seeding season.

Two ways offer for narrowing down this ratio between protein and carbohydrates. The one, more lasting, consists in top dressing the pastures with a phosphatic fertiliser, associated with lime where required. In this way the growth of leguminous herbage either natural or from seeds is encouraged to an extent which may restore in the pasture the albumen ratio to the desired proportion of 1 of the former to 6 of carbohydrates.

The other way, which gives a quick return, is to supplement the ration of the cattle by means of some form of concentrated food, rich in protein or nitrogenous matter. After a time, such a treatment indirectly benefits the composition of the pastures and the more vigorous growth of leguminous plants is stimulated by animal excretion.

Among such concentrates every country offers, in greater or in lesser abundance, are by-products of local factories, which can be bought at a cheap rate.

In Fiji apart from pulse which may be grown for the purpose, the value of mill offal such as rice bran and oil cake meal is not sufficiently generally recognised.

Attention has already been directed to this matter in the last issue of the *Agricultural Circular*, when the respective values of cotton seed meal and of rice meal have been brought under notice.

To revert to the balanced ration of a large size cow in milk, it is found that in the case of Para grass, for instance, yielding about $1\frac{1}{4}$ lb per 100, a ration of 80 lb or about half that required to supply the $2\frac{1}{2}$ lb, of nitrogen required per 1,000 lb weight of the beast, would give about 1 lb of nitrogen, leaving $\frac{1}{2}$ lb to be provided from other sources.

A ration such as follows would provide the needed requirements:—

	Protein.	*Carbohydrates.*
85 lb Para grass	1·03	10·70
4 lb Rice Bran at 12·5 per cent. Protein and 71 per cent. Carbohydrates	·62	2·80
$2\frac{1}{2}$ lb Cotton Seed Meal at 28 per cent. Protein and 50 per cent. Carbohydrates	·70	1·25
	2·35	14·75

Instead of cotton seed meal, a suitable substitute would be found in coconut oil meal which is also rich in protein and is much liked by cattle.

Such a ration would, it is understood, satisfy a large size cow in full milk, while a smaller cow would not require as much.

In most cases, moreover, the animal in the pasture would pick up a certain quantity of trefoil, generally associated with other grasses, and therefore much less concentrates would be needed and probably half the quantity mentioned would suffice.

With succulent pastures and a well-balanced ration, a mineral supplement is essential for normal growth and maximum production. The best way of providing this is in the shape of a salt lick. In the tropics, parasitic worms are more prevalent than in cooler and drier climates, and a lick such as given in this issue in the Notes on "Sheep in Fiji," will be found beneficial for building up the frame-work, and suppressing several of the intestinal worms which sap the vitality of the animal.

COTTON CULTIVATION.

Instructions to Planters.

When two years ago the Government decided to revive cotton growing it selected "Sea Island" because of its superiority over others as regards—

(1) adaptability to a moist and mild island climate;
(2) length of staple, being $\frac{1}{4}$ to $\frac{1}{2}$ inch longer than the average of Upland and other cottons;
(3) appearance, which is soft and silky; it is also characterised by a light cream colour; and higher market value which is a set off against the high sea freight to England.

Other kinds of cotton are being tried in limited field experiments, but until they are proved to be preferable, "Sea Island" will continue to be the kind exclusively cultivated to make certain which are pure type only.

Cotton is a perennial shrub, but under cultivation is considered as an annual crop, and in this Colony the growing of a ratoon crop is not allowed under the regulations.

It grows well and gives excellent returns in the drier portions of Fiji, those parts that have a light rainfall during the months of May to October which are the picking months when dry conditions are necessary.

Soils.

Cotton requires a well-drained soil of good loamy consistency. Heavy soils in which water collects after heavy rain may be suitable for rice, but it is not suited for cotton.

Generally speaking, land which will grow good crops of Arhar dhall or Pigeon Pea will grow cotton. The higher terrace of alluvial sandy loams along the river flats grow good cotton in the drier districts, but good cotton is also produced on black, grey and chocolate soils on the slopes of hill, provided these have a depth of a foot or so of soil and have a sandy, gravelly or stoney subsoil. A soapstone rock or solid clay subsoil are not suitable wherever thay are liable to become water-logged.

Generally the soils of Fiji consist of volcanic rocks, scoria and tufa mixed with decomposed vegetable matter; now and again streaks of marl, marine shells, debris of coral or even crystallised limestones are met with, which all enrich the soil.

As a rule the soils of Fiji are well supplied with nitrogen, particularly rich in potash, while the addition of phosphate, the cheapest of commercial fertiliser, though not essential is generally beneficial.

Preliminary Cultivation.

The land requires to be thoroughly cultivated beforehand. Plough six to eight inches deep a month, or better still, two months before planting; to bury the weeds in, cross harrow; then plough a month later, afterwards work the harrow (henga) to kill new seeds and also to form a fine, firm seed bed. If ploughs are not available, the same results may be obtained on small areas in reed country by burning and cultivating with the spade.

A deep range for the tap root and the searching laterals favour a good root system. Where the natural texture of the soil is not favourable, mechanical digging may achieve the object desired.

In well prepared soil, friable, deep but firm, the young plant will grow more vigorously and quickly get over the critical stage, when it is a few inches high. At that stage, drought, water logging and insect attack affect it more than at a later period.

Contour drains across the sloping ground will prevent scour, especially where the soil is light and friable.

Where the capacity of the soil to take up and retain moisture for effective use by the growing plant, is low cultivation and drainage may rectify any excess either one way or the other.

When to Plant.

A growing season of at least six or seven months is required, the last two or three should be dry. In most cotton growing countries, local customs, the result of experience, may be taken as a guide as regards the best time for planting.

In Fiji the best season is from the middle or the end of November to the beginning of the year, during the summer or rainy season.

The previous crop should have been rooted out and burnt at the latest on the 31st of October, as prescribed by regulations under the Diseases of Plants Ordinance 1913. All cotton plants must be destroyed by the above date.

Six to twelve pounds of seeds per acre, with an average of about 8 lb, are required.

Under conditions favourable for germination, the plants will appear above the ground in four or five days and fresh sowing to supply vacant spaces should follow a week after, if the weather is favourable. In periods of drought the seeds are sometimes two or three weeks in the ground before germinating.

Seed for planting will be available from the end of October at the Government ginnery, Lautoka, and Messrs. Morris, Hedstrom, Ltd., at Ba, Nadi, and Sigatoka at the price of 1d. per pound.

The distribution of seed will remain under close Government control and the indiscriminate importation by private individuals of cotton seed is prohibited with the view of maintaining Fiji Cotton pure of type and of guarding against hybridising.

Spacing.

Correct spacing by giving free access to the plants, facilitates cultivation and finally picking, but it can also control the predominance of the improductive wood limbs or vegetable branches or of the fruiting branches.

By closer spacing in the lines the large spreading wood limbs are more or less suppressed, thus allowing more plants to stand without crowding in the rows and allowing more fruiting branches to develop and mature an earlier crop.

The correct spacing will depend to a certain extent on the class of soil and the locality, and is a matter which each planter will do well to ascertain by experiment. As a general rule it may be taken that the seed should be set one or two inches deep in rows about five feet apart and that the seed should be planted in shallow holes about two feet from each other in the row. The usual procedure is to plant three to four seeds in a hole.

If the configuration of the field is very flat it is sometimes the custom to plough the land into wide, low ridge and furrows and to plant on the ridges to ensure better drainage.

Early planted cotton is not attacked to the same extent by the Tip Worm pest. The small caterpillar of this moth attacks the tips of the branches and if these are nipped off as soon as the grub shows on them the attacks are generally checked.

After Cultivation.

Care must be taken to keep the young crop free of weeds as these retard growth, particularly in the early stages. Thin out when the plants are 6 to 8 inches high, leaving only one plant, the strongest. Last year many growers left two or three plants together, with the result that they were crowded out and gave only a very poor yield.

After thinning out, the land should be intercultivated as often as possible and kept clean of weeds until the dry season sets in and the plants begin to come into bearing. For this work a scuffler or horse hoe is a most useful implement as it enables the weeding to be done frequently and rapidly.

This is as much as the ordinary cultivator may be expected to do. It is at this stage however that the careful planter or the trained cotton breeder, will pick out in the rows inferior plants or any showing signs of variation to the general uniformity of the field. Unless these inferior plants are pulled out, they will blossom and the pollen will be carried by bees and insects to the good plants. The resulting seeds if planted will generally produce plants of inferior quality and will destroy uniformity as regards length, strength, and lustre of the fibre.

The practice of growing crops of cotton in succession year after year leads to the impoverishment of the soil and to the multiplication of pests and diseases.

A rotation is therefore always advisable and preferably a change to a leguminous crop. Cotton has a long tap root and therefore a crop like ground or pea crop with a shallow root system would be advisable. In Fiji the Indian growers are finding by experience the advantage of sowing cotton after a crop of arhar dhall or pigeon pea.

Picking.

The period of picking extends in Fiji from June to October. According to the density of the cotton crop 40 to 50 lb of Sea Island, a small boll cotton, constitutes a fair day's picking when the weather is fine. Of the larger bolled kinds heavier weight can be expected.

Where light soil gives two pickings, a good loam will give three or four.

When picking is done by contract, it is good policy to pay a price that will permit an average worker to make a reasonable wage, without picking carelessly.

Care must be taken to pick as clean as possible because the grade of the cotton depends on its clear appearance and the absence of dirt, leaves, trash and stain.

The time for picking is when the boll is fully opened; if picked too early the fibres are weak and they do not acquire the twist necessary to give them a good spinning quality and the cotton is difficult to dry; if left too long both strength and lustre are lost and the fibres are twisted by the wind and difficult to gin.

The difference in price between high and low grade of the cotton is considerable and it therefore pays the grower to pick carefully. The cotton picked towards the end of the season is liable to be more dirty and stained than that picked earlier, and it should on no account be all mixed together, but kept and baled separately as better prices will then be obtained.

Unless the cotton is picked at the right time and cleanly it is classed in an inferior grade and sells at a greatly reduced price as shown below.

Whatever the grade, it is essential that it be uniform, when it may expect to sell at its full value for that class. A good deal of A grade cotton sells at C or D grade price, simply because it has been carelessly picked and

packed with cotton that may be either stained, matted, weak, irregular as regards length and lustre or because the contents of the bales show bits of leaves or of the capsules of the boll and possibly earth.

Cotton should not be picked when wet and it is always advisable to spread it on a clean mat to dry thoroughly in the sun before storing in the shed.

After storing look at the cotton every few days and if it shows any signs of heating it is probably damp and requires drying again in the sun.

Guaranteed Prices.

The market for this cotton is overseas and as there is a considerable delay in getting the crop the Government has decided to give for 1925 a guaranteed price of 4d. for A and B grade, 3d. for C grade, and 1½d. for D grade for all seed cotton delivered by the grower to the depots appointed in each district. After the cotton has been sold and the price realised, any surplus left after deducting all advances, interest on depreciation of plant, will be distributed as a bonus to each grower, according to the amount of cotton sent in, its grade and the price realised.

THE POSSIBILITIES OF EXTENDING COTTON CULTIVATION IN FIJI.

By Mr. G. Evans, Director of Cotton Culture, Queensland.

On receipt of instructions from the Empire Cotton Growing Corporation, London, and by arrangements with the Queensland Government, I paid a visit to Fiji in July and August, and arrived on 11th July by the s.s. "Niagara."

After spending three days in Suva and its vicinity, I left for a tour of the Colony in company with Mr. A. Despeissis, the Acting Superintendent of Agriculture. I was on tour from the 15th July to the 11th August, and left the Colony on the 15th August.

During the course of my tour I visited the following neighbourhoods: Navua, the Sigatoka Valley, the Nadi and Lautoka districts, Ba, Tavua, and the country between Tavua and Ellington, including Penang.

I then made an inspection of the country at the head of Vitilevu Bay, paying particular attention to the Tova Estate. I then proceeded to Vanualevu and after a short stay at Nabouwalu, visited the Bua area and the Dreketi, Nasarowaga and Lekutu Rivers. In addition I paid brief visits to Levuka on the Island of Ovalau, Wakaya Island, and Moturiki, and returned from thence *via* the Rewa Delta to Suva.

General Features of the Colony.

The Colony of Fiji is situated in the South Pacific between the latitudes of 15° to 22° South, and consists of about 250 islands of varying sizes. The first point that is perhaps most likely to strike the visitor from over-seas is the relatively large size of the two main islands. Residents of Europe and other parts are usually apt to think of these islands as unimportant coral reefs or perhaps of about the size of the Isle of Man. It was somewhat of a surprise, therefore, to find that the area of the whole Colony equalled that of Wales and to discover that Vitilevu, the largest island in the group with an area of over 4,000 square miles, is slightly larger than Jamaica, whilst Vanualevu, the other big island, is 2,128 square miles in extent. In addition there are several other islands of 150 square miles or more in size. Transport difficulties however will probably render it advisable to concentrate at first, so far as cotton is concerned, on the two

main islands. The interior of both these main islands is rugged and mountainous and the scenery is remarkably fine. The valleys are numerous and some of them such as the Sigatoka, the Rewa and Ba on Vitilevu, and the Dreketi in Vanualevu, are 50 miles or more in length and contain large areas of good soil.

The prevailing trade winds are from North-East to South-East, with the result that the windward sides of these islands have a much heavier rain fall than the leeward sides, *i.e.*, the West and North-West. On the windward side the rainfall may average 115 inches, and at Suva the vegetation is heavy and consists of dense tropical forests. Although cotton is said to have been grown in this region in the old days, it was, so far as I could learn, not altogether a success; and there would appear to be a much better chance of establishing the industry on the lee side, where the rainfall averages from about 55 inches to 80 inches or 90 inches, and where there is a definite dry season from May to October, during which the humidity of the atmosphere lessens. At this period showers only occasionally occur. The difference in the vegetation is most marked and in some places the line of demarkation between the two zones can be very clearly distinguished.

The alluvial flats and valleys along the sea-coast in this zone produce cane of high density, and it is in this region also that cotton has so far given the most promising results and has received most attention from the farmers. It has been estimated that about three-sevenths of the land of the Colony is of a mountainous character and unsuited for commercial cultivation. Much of it will no doubt be kept as a forest reserve and it is chiefly situated in the wet zone. A good deal of the remaining area has been considered as only of pastoral value, but I am inclined to think that it has become the custom in this country, where land is as yet relatively abundant, to view the matter only in regard to the possibility of establishing plantations on a fairly large scale. If the possibility of settling the back areas by means of small peasant farmers is considered, it will, I think, be found that the area of arable land is very much more considerable than is at present supposed. The relative paucity of population seems to have led to a general opinion that only the alluvial flats are arable, although the soils on many of the lower slopes of the hills would be considered of good quality in other countries with a denser population. In India, for instance, most of these hills would be terraced and cultivated almost up to their summits.

Land Tenure.

About one-fifth of the area of the Colony has been alienated to settlers. The bulk of the unalienated land is owned by the natives (Fijian), and under certain conditions may be leased with the cognisance of the Government on terms up to 99 years according to the lease.

Rents vary according to the class of land and accessibility to the markets or ports. For good soil capable of growing maize, ground nuts, cotton, &c., 5s. an acre would be demanded if the land is located reasonably near a port or market. I saw one block of rice swamp which the owner was subleasing at 10s. an acre. In somewhat more remote areas the rates are more or less nominal, being about 3d. an acre for the first five years, rising by increments of 3d. every five years to 1s. per acre. There are many blocks of freehold land of first grade quality which are now held by small groups or syndicates. For the most part they are either lying absolutely undeveloped or are merely serving as a run for a few cattle. Lack of capital and absence of reliable markets and to some extent the paucity of suitable tenants are said to be the reason for this regrettable state of affairs.

Population.

The population at the 1921 census was 157,266 persons. Of these 3,878 were Europeans, 85,000 Fijians, and 61,000 Indians. The Fijians are just about holding their own, but the Indians are increasing rapidly from natural causes. For the time being immigration from India has practically ceased. The absence of fever, cholera, &c., and the general salubrity of the climate together with the far better conditions under which he lives as compared with India, suits the Indian admirably, and the Fiji-born Indian struck me as being of a physique greatly superior to that of his parents.

The Indians are mainly engaged on the sugar plantations, although since the indenture system ceased in 1920, an increasingly large number have managed to lease land and have settled down as small peasant farmers. To one accustomed to conditions in India the almost total absence of the caste system struck me as remarkable, and it was also curious to note the inclination of each man to settle on his holding apart from his fellows. There is as yet no tendency towards the formation of the village communities which are so characteristic of life in the great agricultural tracts of India. The Fijians, on the contrary, have definite villages, and cultivate their land on a community basis. The crops they grow are mainly those for their own consumption, and consist of taro, cassava, yams, bananas, &c. In a few places where he has come in contact with the European planter the Fijian has begun to take to the plough, but in most cases he still uses the same primitive methods that his forefathers employed before him.

A brief consideration of these figures will make it evident that the total population is obviously too small for the large extent of land available. Even if all the men anxious to get holdings were to be accommodated, they would make no great difference; and unless, therefore, the population receives a sudden influx by immigration, the development of any industry such as cotton-growing is bound to be a comparatively gradual process. It will expand with the growth in population.

History of Cotton Production in Fiji.

While high prices ruled after the American Civil War, cotton was mainly grown on the plantation system by European planters employing local Fijians, whom it must be remembered were much more numerous then than they are at present, or by cheap labour indentured from other islands in the South Pacific.

Most of the bigger islands in those days grew cotton. Taveuni, for instance, which is now given over solely to copra production, was noted for its cotton, and the same was the case at Kadavu. The planters grew the Sea Island variety, and apparently the quality, from some districts at any rate, was excellent, since a sample from this Colony was awarded the first prize at the Franco-British Exhibition in London in 1908.

During the same period cotton was also grown by the Fijian natives working, as is their custom to the present day, on the community system. Their taxes were paid to a large extent in cotton. The variety grown was a perennial kidney cotton (*G. braziliense*), giving a rather coarse, harsh cotton of staple varying from 1½ inch to 1¼ inch. The Fijians always selected well-drained alluvial flats for their cotton crops, and many of these terraces have been pointed out to me by old men in the villages. In the neighbourhood of these villages one often comes across trees of this variety, relics of the old days. The high prices that have been ruling during the post war period have again stimulated interest in this crop. Selected Sea Island cotton seed was imported from the West Indies three years ago and seed

distributed by the Agricultural Department. European planters are now-a-days few and far between, and, with a few exceptions, cotton is now being cultivated by the small holding Indian peasant farmer. The first ginning factory was constructed at Lautoka last year, and an officer (Mr. L. Field), who has had considerable experience in buying, grading, and ginning cotton in Southern India, was appointed in charge as Cotton Expert. In 1922-23, 33,070 lb of lint cotton were exported and realised approximately £3,500 on the Liverpool market, or rather more than 2s. 1d. per lb as the average.

Transport and Communication.

Considering the relatively large extent of the two main islands, the Colony is singularly badly off for roads. There are less than 100 miles of metalled roads at present, but there are another 100 miles or so in the dry zone which have been gravelled and bridged, and are suitable for motor traffic in fair weather. The major part of the metalled roads are in the neighbourhood of Suva and Levuka, but there is also a fair motor road on the leeward side of Vitilevu which extends from Nadi through Lautoka, right round the coast to Ellington.

The only railways in the Colony are those belonging to the Colonial Sugar Refining Company and the Penang Sugar Company. These railways were constructed with the object of transporting cane from the fields to the mill, and they naturally therefore tap the cane-producing area only on Vitilevu and Vanualevu. The main line runs for about 125 miles along the coast from the Sigatoka Valley through Nadi, Lautoka, and Ba to Tavua; and the Penang Sugar Company have a smaller system which serves their cane area. Similarly, the Labasa Mill on Vanualevu is served by a system of light railways. The Colonial Sugar Refining Company in their Agreement with the Government undertook to carry passengers free of cost, and also transport goods the property of the Government. They have this year, however, raised a strong objection to carrying rice, cotton, &c., on their lines, and the matter was still under discussion at the time of my visit. This light railway, skirting the coastline as it does, taps all the small side valleys and pockets of good soil in the hills where cotton, potatoes, rice, &c., are now being produced mainly by Indian settlers. If transport is refused on the railways, these settlers will experience considerable difficulty in getting their produce to market, since at present they bring it in sledges or on pack animals to the nearest point on the line. It is possible that the more valuable of the products such as cotton might eventually be brought into the markets by motor lorry along the roads and the settlers themselves might eventually learn to cart their cotton into the gin direct from the nearer districts. Unless, however, the transport problem can be solved satisfactorily, it looks as if the areas in the foot hills behind the larger flats will be placed in a serious position, more particularly between Nadi and Sigatoka and at the Tavua-Ba end of the line.

Interinsular communication is not particularly good and apart from a weekly service by small steamers between Suva and points on the east and north coasts of Vitilevu and a similar service to Vanualevu, much of the transport is carried out by small auxiliary vessels and cutters. Trading between the different islands is carried on at irregular intervals. Coastal freights are high, varying from 15s. to 30s. per ton according to the distance. For instance, the owner of a coasting cutter quoted 15s. per ton from the Lekutu River to Levuka and another 15s. from Levuka to Lautoka, so that the cost of freight by cutter from Vanualevu to the ginning factory at Lautoka would be 30s. a ton. In the event, therefore, of cotton developing

into a considerable industry in Vanualevu it would probably pay to erect a small ginning plant on that island. This state of affairs also brings out clearly the necessity for concentration at the present time as the high charge for freight may render cotton production in small areas by isolated growers unremunerative.

There is a direct service of cargo steamers between Suva and the United Kingdom and freights appear to be reasonable, varying from £3 7s. 6d. to £4 5s., according to the class of cargo. Probably a certain reduction could be effected if it is found possible to compress the cotton bales to a greater density before export.

Climatic and Soil Conditions.

Judging from the appearance of the cotton crops that I saw, the leeward side of both Vitilevu and Vanualevu is well suited to the cultivation of Sea Island Cotton so far as climate is concerned, since the rainfall varies from 60 inches to 90 inches and the incidence of the rainfall and atmospheric humidity is comparatively light during the picking months which are from May to October inclusive. The most promising areas in Vitilevu from this point of view would appear to be the areas behind Nadi, Lautoka, and the country between Ba and Ellington, and it is in the former area in particular that cotton is being grown to the greatest extent at the present time. In past years cotton was usually, it is said, planted on river flats and terraces of alluvial soils, and some good crops are being raised on well drained land of this description now. In addition, good results are now also obtained on the grey and black soils, especially where they are not too heavy and where the underlying subsoil is porous and consists of disintegrated basalt or gravel.

The Sigatoka Valley.

The Sigatoka valley would appear to possess great possibilities, at any rate so far as the lower and middle regions are concerned.

I saw cotton crops of the Sea Island variety between Navua and Koronisagana which struck me as distinctly promising. One of these crops was grown by an intelligent Indian cultivator on a secondary terrace of sandy alluvial soil high above the river. He was producing cotton of good colour and texture although there were slight signs of boll rot being present. A second cultivator was getting promising results also on alluvial land in spite of the fact that his methods of cultivation were not properly adapted to the Sea Island type of cotton.

On some of the lower flats along the Sigatoka River which are of considerable extent, it is possible that cotton will grow too much to wood and may become somewhat rank and it seems possible that better results may be obtained on the higher terraces or on the actual slopes. One of the facts that astonished me was the depth of soil that exists on the slopes of the hills, and I should imagine that it would be well worth trying the experiment of planting cotton on the slopes of these hills, because it is quite possible that the crop will do well under such conditions. If it does succeed, and gives remunerative yields, the area that will be available for cotton growing in this valley will be very large. I discussed this matter with the Hon. Mr. P. W. Faddy, who had land in this neighbourhood, and also with the Buli of Koronisagana. The latter assured me that cotton used to be grown in his village a good many years ago, and pointed out the terraces on which it was grown. The variety, however, so far as I could ascertain, was Kidney cotton (*G. braziliense*). I went into this matter carefully with the Acting Superintendent of Agriculture and these gentlemen, and it was

agreed that experiments should be conducted by the Buli on two areas, which were selected on the spot at either end of the village. The sites chosen were high-lying, secondary terraces of light alluvial soil with good drainage, and it is proposed to plant an acre or two of Sea Island cotton on one block and a similar area with Durango cotton. I also made the suggestion that cotton should be tried on the hillside on a piece which was being prepared for taro cultivation, as I think it is very essential that cotton growing should be tested on these slopes.

The Nadi, Lautoka, and Ba Country.

This area comprises the main sugar growing tract controlled by the Colonial Sugar Refining Company. Their railway runs from the Sigatoka valley right round the coast to Tavua. The rainfall varies from about 65 inches at Nadi to 80 or 90 inches in other parts, and the better classes of soil produce good cane crops of high density. The organisation of the Colonial Sugar Refining Company and the great work they have done in developing this part of the Colony command one's admiration. There is naturally a certain amount of nervousness about the introduction of cotton into these cane-growing areas, but I cannot help feeling that there is a good deal of unnecessary misapprehension about the matter. So far as I could see there is no cotton growing on any areas of land suitable for cane, which have been opened up by one of the Company's tramlines. The cane is chiefly grown on the flats along the sea frontage and for short distances inland on the alluvial land along the deltas of certain of the rivers such as the Nadi, Ba, and Tavua Rivers. The bulk of the cotton that is being produced this year has been grown in the neighbourhood, but it is *not* actually in the cane-growing areas. Behind the alluvial coastal flats where the cane is now being grown, the country is broken up into low foothills and narrow valleys going back to the main range of mountains. These little valleys contain pockets of good soils and slopes which are also capable of cultivation. The actual individual areas of good land, however, are so small, scattered, and inaccessible, that it would be practically impossible to bring a cane tramline in to get away the sugar-cane if grown. It is in these narrow valleys and pockets in the hills that the Indian cultivator has settled. The men that I saw were mostly of the ordinary agricultural type one finds among the ryots of India. The majority of them belong to the cultivating castes from Bihar, the United Provinces, and the Punjab. In this class of men the love of the soil is ingrained and they are never really contented unless they have a small patch of soil on which they can construct a house and make a home for themselves. If these men were within reach of a tramline and thus had the means of getting away their produce there is no doubt to my mind that they would for preference grow cane, provided of course the soil were suitable. Experience in various parts of the world leads one to believe that wherever a cultivator has the chance of growing cane and has a really available market for it he will grow this crop, because he finds it more remunerative than any other. This is especially the case in Fiji, where the Indian cane-grower is well looked after by the Company and can receive advances on his crop as soon as it appears above the ground. So long, therefore, as the present facilities for marketing the crop exist and fair prices are given for the cane I do not think there is any likelihood of cotton seriously interfering with the cultivation of cane in those areas which are tapped by a tramline.

There is another aspect of the case that has been raised, viz., that the introduction of a crop like cotton into this area will induce a number of

persons who are at present growing cane to go further inland out of the cane areas and occupy the land. As I have explained above, the good type of Indian cultivator desires above all to have a small and permanent holding of his own. If he can get it in the cane growing areas he will certainly, I think, take it, provided he has some security of tenure. But the men who are growing cotton in the areas behind the cane plantations are already on the land and some of them have been there for several years. They cannot grow cane because the facilities for transport are not there and the economic cultivation of their holding necessitates the planting of a money-making crop. They are at present growing rice in the low-lying swampy portions of their holdings and Arhardhal (*Cajanus indicus*) and maize on the better drained and more sloping portions. These are all food crops which they need for their own consumption. They also require to grow a crop which they can sell for cash in order to purchase some of the necessities of life, such as clothing, groceries, &c. Some of these cultivators are growing tobacco as their money crop; a few are trying potatoes; but the majority of them are now turning their attention to cotton.

The cotton is being grown on small areas varying from an acre to three or four acres at most. The variety grown, Sea Island, is a small boll type and has to be very carefully picked. It is not particularly suitable for cultivation on a plantation scale because of the necessity for picking at very frequent intervals as soon as the individual bolls open. If the picking is delayed the cotton is apt to get stained, and this, in the Sea Island variety in particular, is a very serious fault, since it results in a great depreciation in price. The consequence is that picking is a more or less continuous process and is done almost entirely by the cultivator's women and children. This, I think, is the way that the cotton industry will continue to develop in this portion of the Colony in the future. We cannot expect a very rapid increase in production as this will depend very largely on the rate at which the land is taken up for small holdings. From the point of view of the sugar industry I should imagine that, if the long view is taken, it will be recognised that these back-blocks if settled with small holders will form a potential labour reserve for the cane areas in the near future. If the cultivator in these areas behind the cane flats is discouraged from growing money-making crops, such as cotton and potatoes, and obstacles are put in his way from getting his produce to market, the tendency will be for some of these men to migrate to other parts of the Colony. New men also will naturally settle in areas where they have a better chance of disposing of their produce. If, on the other hand, this form of settlement is encouraged, in a very short time each of these farmers will have a large and growing family of sons who, in order to support themselves, will have to find work outside and will naturally look to the cane plantations for this.

Tavua-Penang Area.

This area is very similar to the above tract, but except for the Penang Sugar Company's area there is at present no cane. I paid a visit to the Yaqara country and consider that there is a large acreage suitable for cotton. The slopes for the most part are gradual and are covered with a good depth of soil, and the rainfall is such that cotton should do well. In the same way the valley of Caboni and the areas beyond also possess great possibilities in this direction. At Ellington, cotton used to be grown in the old days, and excellent results were reported, and there is no reason why it could not be grown again now. Most of the land in all parts of the coast, however, is held as freehold or on private lease, and comparatively little at present appears to have been done towards developing these areas.

With regard to Penang, somewhat similar conditions with regard to labour exists as in the Colonial Sugar Refining Company's country further west.

Vitilevu Bay.

From Ellington South the climate becomes moister and the average rainfall increases. I paid a visit to Nanukuloa and the Tova country. There is an enormous area of good country in this portion of the island, consisting of rolling downs and broad valleys, which for the most part, are free from forest and are covered with reeds and good grasses. The soils are alluvial in the bottom and black or grey on the hillside but some red and chocolate soils also occur, the red soils in particular being perhaps not so fertile as the rest. Taking it as a whole, however, as far as the soil is concerned, the land should be well suited for cotton. It is possible, however, that the rainfall may prove somewhat heavy in certain years. The rainfall at Burenitu at the head of the Bay varied from 83·37 inches in 1920 to 121·23 inches in 1923, and probably averages about 100 inches. I consider, therefore, that it will be advisable to advance with caution so far as cotton is concerned in these areas, and to carry out careful experiments in the first place. It must be remembered that it is not sufficient merely to grow cotton, but that the real test lies in the yield of cotton per acre and in the quality of cotton produced.

I had a long discussion with a number of Indians settled in the Rukuruku Valley and they are anxious to grow cotton so long as some guarantee of price is given and they are assured of facilities for marketing their crops. A number of the men wish to try cotton and will put in small areas as a test this year. I advised them to avoid the heavy land in the bottom of the valley and to try cotton on the slopes where the drainage is good. They are already growing some arhardhal on these slopes and this is a good indication, because this crop requires somewhat similar conditions to cotton. Mr. V. Abel, the manager of Tova Estate, has kindly consented to act as distributor of seed in this neighbourhood, and will also try an experiment with his own tenants.

I also had the advantage of discussing local conditions with Mr. Coster and Mr. G. Bannister. The latter gentleman has agreed to carry out a variety test with Sea Island and Durango cotton on a piece of land on his estate. The site chosen is a sloping hillside with good natural drainage. If this country at the head of Vitilevu Bay proves, after experiment, to be suitable for the production of any particular type of cotton, it would be a promising place for future development, so far as cotton is concerned, because the area of land available amounts to 100,000 acres or more, most of which is free of forest and lies ready for the plough.

Other Parts of Vitilevu.

The Suva and Navua areas and the Rewa Delta were visited, but are situated in the wet zone, and I do not consider them promising, so far as cotton growing is concerned.

Vanualevu.

The dry zone of Vanualevu extends north of Nabouwalu round the leeward side of the island to beyond Labasa. I visited Nabouwalu and made inquiries with regard to cotton growing there. I examined a sample that had been grown in this neighbourhood last year and noted that the cotton was somewhat stained and not of such good quality as that grown in drier parts of the Colony. I also examined a few "standover" plants left from last year and noted that boll rot was prevalent to a considerable degree

although the site for this plot had been well chosen on high-lying, well-drained land. Shield bugs and stainers were also prevalent. I should imagine, therefore, that the climate of Nabouwalu is somewhat on the damp side for cotton. At Bua, however, the conditions are drier. The alluvial flats along the Bua River used to grow good Sea Island cotton in the old days, and there seems to be a large area of land in this neighbourhood which is suitable for the purpose. Most of the holdings appear to be freehold and are as yet undeveloped. There is an Indian settlement of some twenty houses at Luvuluvu near Bua which I visited. The cultivators were willing to give a trial to cotton, but were somewhat discontented as they were on a yearly tenure only and consequently not able to go in for a permanent programme of cropping.

From Bua I proceeded to Dreketi but had not time to go far up the river. I understand, however, that this valley, which is somewhat confined in the lower regions, opens out in the upper part and has large areas of suitable agricultural land. So far as I could ascertain the rainfall and climate are admirably suited for cotton and it would therefore appear that an agricultural survey of these lands on the upper Dreketi would be well worth while from the point of view of the future development of the cotton growing industry, since with the exception of limited copra production, there are as yet no commercial crops being developed in this area.

The country beyond Dreketi and the Nasarawaga valley is poor and consists of a series of small narrow valleys containing only small pockets of moderate soil. The area between these valleys consists of broad plateaux of bright red soil growing nokanoka (*Casuarina*) and fern. These plateaux struck one as being singularly barren although it is possible that they would improve somewhat with cultivation. The area of good soil in this tract is so limited that it would only appear suitable for Indian settlement, two or three families occupying each valley. The Nasarawaga valley, however, possesses a considerable amount of good land along the flats and the slopes of the hills are more gradual and are covered with better soil.

An Indian, Mr. Biggan, has a considerable freehold here, and also has a leasehold and has sublet the land for cultivation to a number of Indians. Further up the valley there is a Government lease at Navibuli on which twenty-eight Indians have been located on a twenty-one years' lease at 5s. per acre per annum. These men are of the cultivating caste and struck me as being of a good type. At present they are growing rice on the heavy flats and maize and dhal on the slopes. They were particularly anxious to try cotton, provided they had some assurance with regard to price and facilities for marketing their crop. There is a large area of land in this valley and its tributaries which is suitable for cotton growing.

I paid a brief visit to the Selesele River where trials had been made with cotton last year. This river has a rapid descent and its valley is a narrow one. The soils consist of chocolate and brown gritty loams which, I believe, if properly cultivated, would grow cotton. It is necessary to emphasise, however, that intelligent methods of cultivation would need to be adopted.

I also visited the Lekutu River and discussed methods of cultivation with Mr. L. N. Anderson, the manager of a coconut plantation there. This gentleman has an intimate knowledge of local conditions, and I was interested to see that he was getting promising results on the chocolate soils on the slopes which it had usually been supposed were of inferior quality. When properly cultivated it seems probable that this class of soil will yield good cotton. Mr. Anderson suggested that the experiment of growing cotton between the lines of newly planted coconuts be made. I think that this

should be tried as for the first three or four years when the coconuts are unproductive it would result, if successful, in a decent revenue being obtained from the land which would otherwise be unproductive. Mr. Anderson agreed to carry out experiments on these lines with both Sea Island and Durango cotton, with a view to helping the Department to arrive at a definite decision with regard to the suitability or otherwise of these two types.

Ovalau Group.

Ovalau struck me as being somewhat on the wet side for cotton. I consider that experiments would be necessary in the case of Wakaya. The amount of land there is somewhat limited except on the eastern side where about 300 acres of red and chocolate soils are available.

At Moturiki the Fijians had been given seed in the past season. This island has been badly affected by the *Levuana* moth, with the result that the copra production has fallen off seriously. It was thought that if cotton succeeded it might help the natives to make some revenue in place of the copra. The Fijian that I talked with was an intelligent man and was giving cotton a good trial in his garden. Unfortunately he did not plant the seed until April which was four months too late and is not likely therefore to get a good crop. The plants, however, which had been sown on a well-drained hillside were looking flourishing and were free from diseases.

Need for Experiment.

At present the only cotton that is being grown is Sea Island, and this variety is doing well, especially where it has been intelligently cultivated and in the drier parts of the island. The main objection to this cotton from the grower's point of view lies in the fact that it is difficult to pick owing to the small size of the bolls. An intelligent Indian grower assured me that the greatest tally he had been able to make in the day was 50 lb. This is possibly a slight exaggeration but it seems to emphasise the difficulty. The natural result has been that many people are asking whether it would not be possible to grow a " big-boll " type of American long staple Upland cotton from which a 100 lb to 150 lb of seed cotton could be picked per day. Applications have been made for Durango seed and Mr. Hopewell and Mr. Brewis have, I understand, the intention of growing this variety on Koro Island. The conditions in Fiji are essentially different, however, from those in where Durango is known to do best. This variety likes a somewhat dry climate with not too much humidity in the air, and it is possible, therefore, that it will not be suited to local conditions. It is possible that it may be affected by a boll rot under Fijian conditions and may tend to go too much to vegetable growth at the expense of cotton production.

Similarly, Pima cotton is being tried under the auspices of the Agricultural Department. A plot I inspected at Lautoka was doing well and the cotton appeared to be bright, clean, and averaging 1⅝ inch staple, but was somewhat irregular in length. Fiji conditions are, however, so different from those under which Egyptian cottons are usually grown that it will be necessary to test this variety very thoroughly before issuing seed to the public in general. Possibly a more suitable variety and one which it would be worth experimenting with is Meade. This is a long staple Upland cotton which is now being developed by the United States Department of Agriculture to replace the Sea Island variety in Florida and the South Sea Islands. It has a staple of 1⅝ inch, is earlier than Sea Island and has a big boll about three times the size of the latter. Whether it will grow in Fiji remains to be proved, but there is a distinct possibility that it will do so. The market value of any new variety would also have to be considered. It would be

advisable to send a 5 lb sample of lint of any such new variety to the Empire Cotton Growing Corporation, who I understand have come to arrangements whereby spinning tests can be carried out on samples of this size.

For the time being, however, I think that it would be inadvisable to distribute any new variety of cotton until it has been thoroughly tested first of all in the field by the Agricultural Department. For the present Sea Island seed should continue to be distributed until it can be replaced by something better. I also consider that for the future good of the industry, all cotton seed should be controlled and distributed by the sole agency of the Agricultural Department. If private individuals are allowed to bring in different varieties for trial the seed will become so mixed in the gins and by cross-pollination that rapid deterioration is bound to set in.

I wish to emphasise the urgent necessity at the present time for experimental work on cotton. At present it appears that little or nothing has been done in this direction. It must be remembered that cotton is a complicated crop and that the market for Sea Island cotton in particular is a very special and limited one. On the whole the Sea Island cotton that has been grown in Fiji this year and last is of good quality, but the market reports on the bales of cotton shipped to Liverpool this year indicate, in the first place, that it lacks the fineness and strength of West Indian Sea Island cotton, and mention is also made of the irregularity in length. These points can only be corrected by careful attention in the first place to the selection of the seed and by improving the methods of cultivation. I feel it necessary, therefore, to urge the necessity for experimental and demonstration work on this crop. I consider that an officer should be appointed as soon as possible, who will be competent to carry out experiments on methods of cultivation, plant selection, and the testing of varieties. In order that these experiments may be properly carried out, it is absolutely essential that some sort of experimental farm should be started in one of the areas which is likely to develop in the near future into a big cotton producing centre. The officer appointed should not only have a fair knowledge of cotton, but should be a man who is well versed in tropical agriculture, and who has been trained in experimental work. He must have experience in the principles of plant breeding because on this latter work will depend very much whether the quality of the cotton is kept up to the mark. The location of an experimental station will be a matter for careful consideration. It will be desirable to select a site which comprises not only typical soils and suitable climate, but which is also accessible, and where the cotton expert will have reasonable social facilities. It must be remembered that if a man is buried away by himself he is apt to get rusty and, in my opinion, it is essential that the man placed in charge of the station should have the means of meeting his brother officers at frequent intervals and so be prevented from getting stale and losing interest in the scientific part of his work.

Demonstration Work.

The immediate necessity for demonstration work is also very apparent. I have mentioned the case of a Fijian, who planted his seed four or five months too late, because he did not know anything about the growing of cotton. Other cases also came to my notice during the course of my tour from which it appeared perfectly obvious that the growers would have obtained very much better crops if they had been given practical advice with regard to the selection of the soil, the time for planting, and details with regard to the preliminary cultivation, the spacing, and after-cultivation. A good deal could be done by issuing a brief leaflet on methods of cultivation of growing cotton, in English, Fijian, and Indian, and sending one of these

leaflets out with each packet of seed, and at the request of the Acting Superintendent of Agriculture, I have drawn up a rough draft accordingly. This however, is only a make-shift arrangement at the best, and what is really required is that one or two itinerant demonstrators should be trained to travel from grower to grower and keep in touch with them and give them advice on the spot. For the Indian settlements it is possible that this could be arranged by means of recruiting one or two intelligent young Indians and training them as ploughmen on the experimental farm when it is started. They would need to be thoroughly trained in practical methods by the Cotton Expert and after a few months training could probably do good service in visiting the Indian growers in the various cotton growing tracts.

Insect Pests and Diseases.

On the whole the cotton crops inspected were not seriously attacked by pests or diseases. The Tip Worm (*Earias fabia*) was observed but is said to be chiefly active from the middle of April to the middle of June. One of its main forms of attack is to bore into the leading shoots and the ends of the branches, causing an abnormal habit of growth and it is found to be particularly severe on late planted crops. Sowings in November and December are therefore generally recommended. I observed the Pink Boll Worm (*Platyedra gossypiella*) in localities so far apart as Sigatoka and Tavua, but nowhere was much damage from this cause noticed. At present also it must be remembered the cotton fields are few in number and scattered at some distance apart and this pest is more likely to increase in importance as the area under cotton expands. The Government have already issued an Ordinance requiring that all cotton bushes should be uprooted and burnt by the end of October and forbidding the ratooning or standing-over of the crop for a second year. This regulation is a wise precaution against the spread of this and other pests and, if properly carried out, should result in keeping them in check.

A Shield Bug (*Tectocoris lineola*), somewhat similar to the Queensland variety, is prevalent on the coast but is not as yet so bad a few miles inland. The alternative host plant for this pest is said to be the Moola Moola (*Thespesia populnea*), a strong growing bushy shrub which is found on the edges of the mangrove swamps. This bug possibly does a good deal more damage than is generally supposed since in addition to sucking the sap from the young bolls it may give a means of entrance to certain of the fungi and bacteria causing boll rot. Cotton stainers (*Dysdercus spp*), were also in evidence more particularly on the few stand-over crops observed. On the whole, however, they are not abundant but may increase towards the end of the season. Angular leaf spot and *Anthracnose* are said to exist, but were not in evidence at the time of my visit.

The boll rot mentioned above is noticed some distance up the Sigatoka valley and also here and there in the Nadi and Lautoka areas. It was nowhere very prevalent and in fact Sea Island variety was on the whole singularly healthy and free from disease where it had been properly cultivated. Whether the long staple Upland varieties, which there is an inclination to try on account of their bigger bolls and easier picking properties, will prove equally free from attack remains to be seen. On the coastal areas of Queensland, Upland varieties in a damp season are subject to boll rot and it would be therefore unwise to issue seed of an Upland cotton or, in fact, of any new varieties until it has been thoroughly tested under various conditions by the Agricultural Department.

Need for Concentration.

At present cotton is being tried at various places all over the Colony and the question of the transport and handling of the crop is presenting serious difficulties. The one ginning factory at present erected is at Lautoka, and although this serves the Nadi, Lautoka, and Ba areas the cost of transport in districts further away is very considerable so that it practically cuts out the cotton produced on Vanualevu and other islands. I am of opinion, therefore, that it would be advisable for the time being to concentrate as much as possible on particular areas as this would enable the crop to be transported, handled, and ginned very much more economically. It must be remembered that in Sea Island cotton only about one-fourth is lint and the rest is seed which is not nearly so valuable as the lint, and that therefore it does not pay to transport the cotton for any great distance in the seed.

It is suggested that a suitable site for one of these cotton growing centres would be Nasarawaga. As I have pointed out above, the soil and climate of this area would appear to be suitable for cotton growing. There is at present no other established industry such as sugar-cane and there is already a settlement of about 100 families of Indians who are anxious to grow a commercial crop. If it were found possible to throw open this valley for Indian settlement and also a portion of the Crown lands between the Nasarawaga valley and the upper waters of Lekutu, it is probable that a successful Indian settlement could be established there, and a substantial cotton growing industry started. There is probably room for at least 800 or 900 families in this area, but it would be necessary in the first place to survey the land and cut it up into blocks. Each family might be given from ten to twelve acres of alluvial land or good soils on the lower slopes of the valleys, and each holding would require twenty to thirty acres of grazing land as well on the hillsides. The holdings should be so designed as to include a frontage on the creeks with the grazing land behind and it is worth considering the possibility of constituting communal grazing grounds for groups of Indian settlers. If some scheme of this sort were found possible it would be necessary in the first instance to establish a small ginning factory at Nasarawaga or Dreketi to deal with the crop. Probably for the first year a one-stand gin would suffice and the number of stands could be added to as the crop increased. It would be necessary also to erect a storage shed near the ginning factory so that Mr. Field, the Cotton Inspector, would be able to pay a visit with his staff from Lautoka and gin the crop from this area after he had finished his Lautoka operations. Provided this scheme was put into operation it might also include eventually the land on the upper Dreketi, if investigation proves that it is suitable for the cultivation of cotton and other crops. The best place for the Experimental Farm would be somewhere in this neighbourhood in the event of the Lautoka area being discouraged from cotton growing. The disadvantage would lie in the fact that the manager would be located in a remote and somewhat inaccessible place and would be somewhat cut off from the social amenities of life. This would not be the case at Lautoka and it might therefore be worth considering re-opening the former Experimental Farm near the District Commissioner's headquarters, near Lautoka.

Arrangements on Vitilevu.

With regard to the handling of the crop on Vitilevu, matters are complicated owing to the unwillingness of the Colonial Sugar Refining Company to transport cotton on their railways. For the time being the Lautoka

ginnery will still serve a useful function as it is probable that a certain amount of cotton will always be grown in this neighbourhood. The small pockets and narrow valleys behind the cane growing area are already occupied by Indians all of whom are growing cotton on small areas, and at any rate in the neighbourhood of Lautoka they are likely to continue to do so. Even in the Nadi valley and on the upper Sabeto it seems probable that some sort of arrangements could be made to transport cotton, supposing it is not found possible to transport it on the railways. In India the cultivator thinks nothing of transporting his cotton for twenty miles or more by road. In Fiji it is a remarkable fact that the Indian settlers have not yet learnt to use the bullock waggon and only use a most primitive form of sledge called a "gazita." I believe that if a few pairs of the cartwheels used in the country district of the Deccan or Central Provinces were imported into Fiji and used as samples that in a very short space of time the use of bullock carts would be introduced and encouraged. The country is certainly not more difficult than in those parts of India that I have mentioned. If bullock carts were introduced the cultivator could bring his cotton in direct to the gin at Lautoka from the nearer areas.

As far as experimental work on cotton is concerned in this area Mr. Field has made arrangements with Rev. Mr. Piper, Lautoka, to carry out definite tests with varieties of cotton on his land and a duplicate test could probably be arranged on one of the cultivator's fields in the Nadi valley. It will be necessary in the first place to carry out a test between the Sea Island, Pima, and Durango cotton, and if Mr. Piper could arrange for a small isolated plot to be set aside for the testing of Meade it would be a great advantage.

Grading.

The variety grown is Sea Island, selected seed having been imported from the West Indies three years ago by the Department of Agriculture. I had the opportunity of seeing a large number of fields and examining the cotton produced. Where the crop had been grown under good conditions of soil and cultivation excellent cotton is being produced averaging from $1\frac{7}{8}$ inch to 2 inches. Where unsuitable soil had been planted and where the cultivation was not carefully carried out it was noticeable that the length became more irregular and, varying from $1\frac{5}{8}$ inch to 2 inches, and the quality fell off. In certain districts I noticed the presence of green, unfertilised seeds in the locks. These neps were not generally prevalent and may be due to a seasonal effect as the earliest part of the growing season is said to have been unusually dry.

Considering that this variety is new to the Indian growers and that the Department has as yet been able to devote little time and attention to experimental and demonstration work on this crop I consider that good results are being obtained, but it is nevertheless obvious that much spade work will be necessary in order to educate the grower and get him to recognise the importance of quality. Mr. Field, the Cotton Inspector at Lautoka, has wisely laid down a simple set of grades for seed cotton and a considerable differentiation in price between the grades is being made with a view to encouraging the grower to pick clean and to keep his pickings from the first half of the season separate from the late cotton which is more apt to be stained.

Guaranteed Prices and Market.

There is no local market for cotton which accordingly is shipped to the United Kingdom. It must not be forgotton that Sea Island cotton has a

very special and somewhat limited market with the result that a delay of six months or more may occur between the time the grower delivers his seed cotton to the date of actual sale. At the present stage of development the Government has had to finance the grower therefore and has adopted a system of advancing a certain proportion of the value of the crop to the grower on delivery of his seed cotton. On the past season's crop of 101 bales an advance was made to the grower for seed cotton delivered at certain named depots according to grade. After the sale results were known a further bonus was distributed in accordance with the grade of seed cotton originally sent in. This is shown in the table below:—

Grade.	Price advanced on delivery.	Bonus after sale.	Total.
A	2d. per lb	3d.	5d.
B	2d. per lb	3d.	5d.
C	1d. per lb	1½d.	2½d.
D	1d. per lb	1½d.	2½d.

A good deal of dissatisfaction with this system was in evidence. The original advance is probably too small in proportion to the real value to attract the small grower and particularly the Indian at this stage of development. This class of grower does not understand the method and would much prefer some system whereby he could sell his crop outright for a sum which is nearer its full value since he requires the cash to finance his crops for the following season. A good many of the growers do not understand that a bonus would be eventually forthcoming. Every care should therefore be taken to have the system thoroughly explained to the grower in the future as undoubtedly in some districts misconception of the objects and aims of the Government and of their policy has led to a good deal of discouragement amongst potential growers. Having in view the fact that the Government is now able to gauge approximately the value per pound of the cotton grown and also having in mind the necessity for clean picking and high grading it is suggested that in order to meet the existing doubts and difficulties of the small grower it should be possible to announce guaranteed advances on the present season's crop somewhat in accordance with the scale tabulated below:—

A Grade	.. 4d. per lb	The balance to be distributed as a bonus after sales are completed.
B Grade	.. 3d. per lb	
C Grade	.. 2d. per lb	
D Grade	.. 1½d. per lb	

Another point which would help to encourage the growers and give them a sense of security is a definite pronouncement by Government to the effect that this system of guaranteed advances will be continued for the next two or three years. This will be necessary as until sufficient cotton is grown in Fiji to attract overseas buyers, Government will have to continue to handle the crop. The alternative is the creation under the auspices of the Government of a ginning, baling, and marketing association in which the Government, growers, and business men of the Colony are represented, to finance and handle the crop. Some central organisation will probably be eventually necessary to ensure that all cotton produced in the Colony is of similar type and is graded, ginned, and baled on a uniform basis. There is no room

for the idiosyncrasies of the individual in the cotton trade, standardised types only are in demand.

Ginning and Baling.

There is one small ginning factory in the Colony at Lautoka. This is centrally situated for the Vitilevu dry belt, provided of course the transport difficulties mentioned above are overcome. This factory has three stands and is equipped with Platt's Macarthy single acting roller gins. There are three oil engines so that there are three single units. Each gin is capable of turning out 800 lb of Sea Island lint per day of ten hours.

Baling is at present done by a hand wool press which gives a pressure of 13 to 14 lb per cublic foot. The size of the bale for export is 4 feet 2 inches by 29 inches by 29 inches; no hoops or lashings are used and the net weight of the bale is about 330 lb. It is probable that a less bulky bale could be produced and inquiries are now being made with a view to ascertaining the maximum pressure that can be applied to this class of cotton without deteriorating the fibre. The ginning and pressing costs are at present rather high but as Mr. Field rightly points out his labour is quite unskilled and raw and there are one or two minor mechanical defects which he has now been able to correct.

Lines of Development.

There are three possible ways in which cotton growing can be developed in Fiji in the future. In the old days at the time of the American Civil War, cotton growing in Fiji was mainly on the plantation system by European planters. In those days, however, labour was much cheaper than it is at present and was probably a good deal more abundant. At the present time labour averages about 2s. 6d. per day, and it is somewhat doubtful therefore whether it would pay the planter so well, although, if the price of cotton remains high, it is quite possible that on a moderately sized and carefully managed estate cotton growing would form a useful subsidiary to other forms of agricultural production. So far as I can see, however, the immediate future of cotton growing in these islands depends to a considerable extent on the development of a system of small peasant farmers and it seems likely that if the Indian is settled on small holdings in the dry areas which have been proved suitable for cotton growing, he will do a great deal to develop and expand this crop. We have also to consider the possibilities of cotton growing by the Fijian population on the community system. We have had the opportunity of talking to several of the chiefs and headmen of villages on this particular point, and it seems desirable that an attempt should be made to try cotton growing on this system. It would be necessary however, to aim at introducing some system of agricultural education among the Fijian natives with the object of gradually training them to the use of the plough, as at present they are unacquainted with any implement except the spade and the " doko." In former years quite a considerable amount of cotton was cultivated by the Fijians on the community system and in nearly every village situated in the dry zone the Buli will show you areas which were formerly reserved for the cultivation of cotton. It would seem worth while, therefore, to pay particular attention to this aspect of cotton growing.

Ultimate Prospects.

These are difficult to forecast. The main factor is that of population, since this is too small for rapid development. The staple industries are sugar and copra. Sugar production is confined to a strip of coastal lands about two miles wide on the average, extending round the coast of Vitilevu

from Sigatoka to Tavua, to a small area near Penang in the dry belt, and at Nausori in the Rewa delta, in the wet zone. At Vanualevu, the Colonial Sugar Refining Company has considerable sugar plantations near Labasa. So far as copra is concerned the main production appears to be on parts of Vanualevu, Taveuni, and the numerous islands on the windward side. Ovalau, Vitilevu, and some islets on the leeward side of the group have been badly affected by the depredations of the *Levuana* moth which has seriously curtailed production in the last two or three years. So far as I could judge there is a large amount of country amounting to many thousands of acres in the dry zone of both big islands at present lying unproductive which could grow good cotton and which is not likely to be utilised at present for either sugar or copra production. The problem lies not in the lack of land but in the settlement of it and in the relative paucity of population. Doubtless now that cotton has proved its economic value much of the good lands, a large proportion of which is held by syndicates, and absentee landlords, will be made available at reasonable rents and on long lease to intending cotton growers. The Government also intends to consider the possibility of throwing open some of the Crown lands for settlement on this basis. These settlers will be mainly Indians since the latter have shown an increasing tendency to settle on the land now the indenture system has been broken. Many have already settled and numbers of them are only waiting a favourable opportunity for getting on the land. If suitable measures on these lines are adopted, therefore, it may be expected that the cotton production will show a relatively rapid increase during the next three or four years. After which it will automatically slow down as the number of settlers available becomes exhausted and will depend either on the natural increase of the resident population or on some system of augmenting the population by immigration.

The estimated area this season 1923–24 is under 1,000 acres. In the next three years the area may increase up to four or five thousand acres and in ten years time to as much as 10,000 acres, but this is not likely to be exceeded unless something unforeseen occurs such as a sudden influx of population or a temporary slump in one of the staple products of the islands which would release more man-power for cotton production. The land suitable for cotton production exceeds this figure very considerably, and ultimately Fiji might become no mean contributor to the world's cotton requirements.

Conclusion.

1. It is recommended that so far as Vanualevu is concerned Crown land on the Nasarawaga River and on the head-waters of the Lekutu and Dreketi, be surveyed and designed into blocks suitable for Indian settlement with a view to establishing a compact cotton growing industry in this neighbourhood.
2. That an additional Cotton Expert be appointed, whose duty it will be to carry out plant breeding on cotton with a view to raising new and improved types. He will also be responsible for testing new varieties and for carrying out experiments on the cultivation of the crop.
3. That an Experimental Farm for cotton be established either near Lautoka or in the Nasarawaga neighbourhood. Experiments carried out at either place would probably apply to most of the cotton growing areas in the Colony.

4. That one or two itinerant demonstrators be trained by the Cotton Expert, when appointed, on the proposed Experimental Farm. Their duties will be to advise the growers in the best methods of growing and harvesting the crop.
5. That the ginning factory at Lautoka be continued for the time being and, if necessary, a small ginning plant be erected near Nasarawaga.
6. Experiments to be carried out with Durango and Sea Island cotton respectively on areas selected at Vitilevu Bay (Mr. G. Bannister); Lautoka (the Rev. Mr. Piper); Nadi, Sigatoka, Lekutu, and Nasarawaga. That experiments be made with Durango and Meade, and that the United States Department of Agriculture be asked to supply the seed of the latter.
7. That a brief bulletin describing the method of cultivating cotton be published and issued.
8. That the Agricultural Department assume control of all seed supplied to the growers and that no seed be imported into the country except through the Agricultural Department.
9. That the existing regulations in regard to the enforcement of the close season be enforced as this is a necessary safeguard for the future of the industry.
10. Government to make a definite statement of policy with regard to guaranteeing the crop for three or four years and to make arrangements for the prompt payment of the guaranteed sum as soon as the cultivator delivers his cotton at a certain specified depot.

APPENDIX.

Rainfall Statistics.

I.—Average Rainfall, Vitilevu Cotton Zone.

Month.	Lautoka. 1900/20.	Nadi. 1902/20.	Sigatoka. 1911/20.	Ba. 1902/20.
	in.	in.	in.	in.
January	8·76	8·53	8·26	8·30
February	12·29	11·74	7·50	11·0
March	10·83	9·16	8·24	9·3
April	4·73	4·25	4·84	4·62
May	3·79	3·29	5·27	4·25
June	2·24	2·25	2·53	2·62
July	1·89	1·93	2·55	2·19
August	3·98	2·91	2·35	2·76
September	1·63	1·83	2·94	1·76
October	2·75	2·63	3·21	2·80
November	3·55	3·83	3·70	3·65
December	7·75	8·93	7·82	7·84
Total ..	64·19	60·38	59·21	61·09

II.—Rainfall at Burenitu, Vitilevu Bay.

Month.	1919.	1920.	1921.	1922.	1923.
	in.	in.	in.	in.	in.
January ..	13·07	2·88	21·35	14·80	19·74
February ..	9·33	10·58	15·20	8·59	17·62
March ..	7·18	18·20	12·73	11·58	21·00
April . ..	11·66	23·01	20·64	17·68	8·64
May	·74	3·14	2·27	9·07	11·37
June	3·80	2·61	2·42	1·44	7·70
July	4·57	1·71	·1·73	3·61	2·77
August ..	6·68	3·53	3·92	2·41	1·92
September ..	2·67	2·85	3·59	14·21	5·67
October ..	5·31	·68	2·31	7·06	3·24
November ..	9·38	1·20	8·78	17·65	9·61
December ..	11·14	12·98	20·28	9·09	11·95
Total ..	85·53	83·37	115·22	117·19	121·23
No. of wet days	146	133	156	116	146

III.—Rainfall at Delanasau, Lekutu River, Vanualevu.

Month.	Period 42 years 1881–1913.	Year 1923.
	in.	in.
January	13·50	25·29
February	11·13	3·41
March	15·83	17·03
April	8·28	..
May..	3·77	9·27
June	2·12	4·75
July	1·80	1·86
August	2·22	·18
September	2·98	·63
October	4·91	..
November	5·36	3·50
December	9·18	7·94
Total ..	91	73·86
Number of wet days	190	..

Since 1913 the rainfall has shown a tendency to become somewhat less, and the average for the whole period is just over 80 inches.

COTTON INDUSTRY.

THE following figures prepared by Mr. A. B. Ackland, Secretary of the Cotton Branch of this Department, present in a tabulated form figures bearing on the Fiji Sea Island Cotton crop.

The 1924 crop of lint shipped to the United Kingdom amounted to 180 bales containing 61,199 lb (27 tons 6 cwt. 1 qr. 19 lb). The 1923 crop shipped amounted to 101 bales containing 33,072 lb (14 tons 15 cwt. 1 qr. 4 lb). The increase over the 1923 crop is 85 per cent.

The quantities of the various grades, with percentages of the crop, are shown hereunder:—

Sea Island.

	1923 *Crop.*		1924 *Crop.*	
A. Grade	3,466 lb,	10·5 per cent.	15,554 lb,	25·7 per cent.
B. Grade	17,281 lb,	52·3 per cent.	15,633 lb,	25·9 per cent.
C. Grade	8,915 lb,	26·9 per cent.	16,739 lb,	27·7 per cent.
D. Grade	3,410 lb,	10·3 per cent.	10,576 lb,	17·5 per cent.
E. Grade	.....		983 lb,	1·6 per cent.
F. Grade	.....		943 lb,	1·6 per cent.
	33,072 lb,	100·0 per cent.	60,428 lb,	100·0 per cent.
Pima	.....		771 lb	
	33,072 lb		61,199 lb	

Average weights and measurements per bale were as follows:—

	1923 *Crop.*	1924 *Crop.*
Weight	327·4 lb	339·9 lb
Measurement	25·1 c.ft.	24·1 c.ft.

FIJI COTTON IN ENGLAND.

EARLY in March the Department of Agriculture requested Sir Maynard Hedstrom, in London, to follow up the consignment of 101 bales of Sea Island Cotton, consigned to the Empire Cotton Growing Association in December last, and obtain if possible the opinion formed by the trade and also a sample of the goods as it leaves the looms.

To this communication a reply has been received enclosing a copy of a letter received from Mr. Thomas Oliver of Messrs. Thomas Oliver & Sons (Bollington), Limited, Waterhouse Mills, Bollington, near Macclesfield, who bought most of the Fiji cotton and who says:—

My firm bought nearly all the shipment of Sea Island cotton shipped from Fiji, 28th December. My firm bought nearly all the cotton shipped from the Fiji Islands thirty to forty years ago. I prefer the cotton you have recently shipped to what used to be shipped a generation ago, because, although the fibre is not so long, the cotton is picked properly *ripe*, carefully picked, and very nicely ginned and it is consequently easier to work. I have not used the last shipment in bulk but have put samples through to test.

If you can continue to grow cotton like the last shipment it will always command a ready sale—of course fresh seed must be planted every year. The plant must be pulled up and burnt every eason, otherwise you will be in danger of disease. On no account must an attempt be made to ratoon cotton.

May I ask from which seed the cotton shipped, 28th December, 1923, was grown? It would be well to obtain seed from the same source again. As to your query whether you should grow Queensland cotton, if you can continue to grow such cotton as the last crop it would be unwise to change on to a coarser variety. Inasmuch as we only spin cotton and double it and do not weave any goods, I cannot send you any goods, but I believe in the St. Vincent, West Indian Section, you will find some goods which I procured made from St. Vincent, West Indian cotton which would show you some of the classes of goods into which your cotton would also find its way.

The cotton was grown from seed imported by the Government from Barbados.

FIJI COTTON.

Bulletin No. 13, published in 1920, supplies general information regarding the cultivation of Sea Island cotton in Fiji. A pamphlet containing the latest instructions regarding planting, &c., has since been published in 1924.

In 1922 the Government introduced seeds of the Sea Island variety from Barbados, in the West Indies, with a view to reviving the industry and this variety is practically the only one grown. Seeds of Durango, Pima, and a small quantity of Meade have been introduced for trial under conditions having full regard to retaining the purity of the Sea Island strain, and of these Pima has shown the best results to date. It is anticipated however that Sea Island will continue to be the variety principally favoured.

The quantity exported during the 1923 cotton season was 101 bales containing 14¾ tons of lint, of which 10·5 per cent. was of first quality, while that exported for the 1924 season was 27¼ tons, of which 25·7 was graded as first quality.

Cotton is, at present, grown at Ra, Ba, Lautoka, Nadi and Nadroga, and the Government has erected a ginnery with up-to-date machinery at Lautoka where the crop is ginned and baled.

Seed cotton is received by Government agents at recognised centres in each district and advances made thereon according to quality. For the 1924 crop advances of 4d., 3d., 2d., and 1d. per pound of seed cotton were made for A, B, C, and D qualities respectively and these rates have been guaranteed for the 1925 crop also. Government meets cost of transport to ginnery, ginning and baling costs, and all expenses to sale in the United Kingdom. When the proceeds of sale are available the advances made and the cost of ginning and marketing, &c., are deducted therefrom and any balance remaining distributed amongst the growers. For the 1925 crop, regarding which figures are available, the growers received advances of 2d. and 1d. per lb, according to quality, and final payments of 3d. and 1d. per lb of seed cotton supplied. On a ginning extraction of 25 per cent. the amount paid for first quality represents 1s. 8d. per lb of lint.

The Empire Cotton Growing Corporation has been interested in the Government's efforts to revive the industry and has offered to supply to Government ginning machinery up to £500 in value to be paid for by instalments over a period of three years. It is possible that this consideration would be extended to reputable planters. The British Cotton Growing Association has undertaken the marketing of the crop.

The cultivation of cotton is, so far, principally in the hands of East Indians, who tend small areas and no definite information is therefore available regarding cost of cultivation, picking, &c. The Cotton Inspector has been requested to obtain as much information as possible on this point.

From figures available regarding the 1923 crop the following particulars are extracted:—

The average value per lb of lint sold, including seed sales, was 24·9d. per lb, whereas cost of ginning and marketing, &c., including all charges, was 7·83d. per lb. Government did not however, for this reason, make any charges for the services of the Cotton Officer or for interest and sinking fund, which reduced the cost for the purpose of arriving at the amount available for final distribution to 5·41d. per lb. These figures refer to the first season's operations and it will probably be found that, with increased crops, the cost will be reduced. Freights are high and the rates paid were

£1 per ton measurement from Lautoka to Suva and £4 per ton measurement from Suva to Liverpool or approximately 2·3d. per lb.

The 1924 crop contains a greater proportion of A grade lint and the average price realised should be greater than that for 1923, provided of course that the market remains steady.

Approximately 4 lb of seed cotton are required to obtain 1 lb of lint.

Reports on the lint shipped during 1923 season are entirely satisfactory, as can be seen elsewhere in this *Circular*, the purchasers stating that the quality is well up to standard and superior to that of cotton grown in Fiji in the past.

The press used in Fiji is a standard wool press which turns out bales measuring about 24 cubic feet and containing 340 lb lint.

The cost of erecting a small ginnery suitable for a plantation of 250-300 acres with an average yield of 600 lb of seed cotton per acre is estimated at about £800. This estimate includes a galvanised iron ginning and pressing house, 30″ by 18″ by 12″; a cotton store, 50″ by 20″ by 12″; and office, 12″ by 12″ by 10″; one single-acting roller gin; one 2½ b.h.p. Crossley engine; one standard wool press and scales. To this should be added duty and transport.

The importation of cotton seed, seed cotton, and ginned cotton is prohibited except under a written permit from the Superintendent of Agriculture. All seed produced in the Colony is retained at the ginnery and selected seed, after fumigation, sold for planting at 1d. per lb plus shipping charges (if any). The balance of the seed is disposed of by Government and the proceeds devoted towards adjusting advances made or cost of ginning, &c. The surplus seed of the 1924 crop was disposed of at £5 per ton f.o.b. overseas steamer Suva.

Ratooning is prohibited. All plants must be uprooted and destroyed by fire in October of each year and no seed planted for at least one month.

A list of the pests attacking cotton in Fiji is published in the *Agricultural Circular*, Vol. III, No. 3. The experience of two seasons cultivation is that pests cause very little loss. Loss caused by the pink boll worm is not apparent.

The average yield of seed cotton at the Lautoka Experimental Station for the years 1906-1915 was 528 lb per acre. The 1924 crop grown by Indians and others yielded an average of 424 lb per acre, but it must be remembered that many of the growers are quite inexperienced. With careful cultivation on up-to-date lines there should be no difficulty in increasing this average.

Indian labourers are most suitable for cultural operations and picking. It is not anticipated that there would be much difficulty in obtaining sufficient labour for cultural operations but, for a large area, picking might present difficulty. Fijian labour for this operation would probably be available if there was a native village in the neighbourhood. In this connection attention is invited to the paragraph on lines of development in Mr. Evans' report.

In August last the Colony was visited by Mr. G. Evans, Director of Cotton Culture, Queensland, and a copy of his report is reprinted in this issue. Recommendations contained therein are now receiving consideration.

SECOND SALE OF FIJI COTTON.

INFORMATION to hand on going to press surpasses the most sanguine forecast of the probable price last year's Sea Island cotton crop was likely to realise.

Another satisfactory feature of the business is that the spinnners' price in England tallies bale for bale with the grade mark placed on them by the Cotton Inspector, Mr. B. L. Field.

Of the last season's output 157 bales were shipped to the United Kingdom on the 27th November last and the balance, 23 bales, on the 7th February. The prices realised for the first consignment are given hereunder:—

	Sea Island.		
A Grade	.... 43 bales	....	37·00d. per lb.
B Grade	.... 44 bales	....	36·50d. per lb.
C Grade	.... 44 bales	....	35·00d. per lb.
D Grade	.... 23 bales	....	34·00d. per lb.
E Grade	.... 1 bale	....	32·00d. per lb.
	Pima.		
Pima	.... 2 bales	....	36·00d. per lb.

The total quantity disposed of in this consignment was 53,587 lb, the average price realised (gross) being just over 2s. 11d. per lb.

The prices realised are very encouraging and should stimulate the production of cotton in the future. The price at which the Pima variety was disposed of its worthy of note, as this variety is a strong grower and yields heavily. The comments of the brokers and of the spinners will be awaited with interest regarding the advisability of extending the cultivation of this kind of cotton. In any case, should the recommendation of the Empire Cotton Growing Corporation and the British Cotton Growers' Association be favourable, care will be taken that it is planted in districts where no Sea Island cotton is growing.

The average price realised per lb for the previous season's crop was 1s. 11d., so that the market has shown an appreciable increase or Fiji cotton has established itself with the spinners.

BRITISH COTTON GROWING ASSOCIATION AND FIJI COTTON.

As evidence of the practical interest taken in the revival on sound lines of cotton growing in Fiji, the following extracts from correspondence with Mr. W. H. Himbury, the General Manager of the British Cotton Growing Association, are circulated for the information of many whose attention is turned to cotton growing.

In a communication to the Under Secretary of State, Mr. Himbury, commenting on Mr. G. Evans' report upon his investigations in Fiji, expresses himself as under:—

In our letter of the 15th August last addressed to the Secretary of State dealing with the subject of cotton growing in Fiji, we expressed the opinion that Sea Island cotton ought to do well and that it should prove a remunerative crop to the grower; furthermore that the shipment received was generally satisfactory. We should again like to point out that if experiments with other varieties are carried out, it is exceedingly important that the areas over such should be isolated, as otherwise there is a danger of hybridisation, which would seriously affect the value of the Sea Island crop.

As regards the ginning factory at Lautoka, the machinery for this was supplied through this Association, and if the local authorities, or a combination of growers, require further machinery, we should be very pleased to give our favourable consideration to any proposals they may make by supplying their requirements on easy terms of payment.

As to whether 4d. per lb of seed cotton can be paid depends largely on market conditions on this side. The lint production of Sea Island cotton varies from 22 per cent. to 25 per cent., and, taking the higher figure, 4d. per pound of seed cotton means 16d. per pound of lint, plus the cost of ginning, freight, marketing, &c., To-day, this price might be paid, but I think it will be safer to base a price on 20d. per lb in Liverpool.

The question of starting the cotton growing industry in Fiji on right lines being of such great importance, I considered it advisable to send copies of your communication to Messrs. Wolstenholme & Holland, who have been brokers for many years for Sea Island cotton and may be considered as the greatest authority in this country on its value, and also to Mr. E. L. Oliver of the Fine Cotton Spinners' Association, who purchased last season's crop of Fiji cotton and, being the users, would be well acquainted with its defects, and I have pleasure in sending you herewith, in full, copies of their letters containing criticisms and suggestions, all of which will be helpful to the authorities in Fiji.

COTTON SPINNERS' ADVICE.

In a letter addressed to Mr. W. H. Himbury, General Manager of the British Cotton Growing Association, Mr. E. L. Oliver of the Fine Cotton Spinners' Association, who purchased last season's crop of Fiji cotton makes the remarks reproduced below.

Being the users, the writer would be well acquainted with its defects and therefore the advice tendered is the more worthy of notice.

Two things, says Mr. E. L. Oliver, strike me, referring to Mr. G. Evans' report:—

1. They mention the small quantity of cotton which can be picked per day, never exceeding 25 lb per diem and complain that they have to pick so frequently to prevent the cotton falling on the ground or getting stained. The only criticism I have to offer of this, otherwise excellent cotton, is that some of it is picked before it is ripe. They are evidently so afraid of some of it falling out of the boll that the fibre is, some of it, picked unripe.

They should leave the boll exposed to the sun and wind longer than they do in order that the fibre may ripen and get the natural twist which a spinner likes, even if it results in a slightly higher percentage of stained cotton.

2. They talk of experiments with different types of cotton and I infer that these experiments occur side by side. Is this not a danger?

They talk of the necessity of not mixing seed, but will not pollinisation, hybridisation and cross fertilisation occur if the experiments of different breeds of cotton are conducted in the same area? May not it be just as dangerous as mixing the seed?

Mr. C. M. Wolstenholme, Liverpool, of a firm of brokers for many years of Sea Island cotton, writing to the General Manager of the British Cotton Growing Association sets out his views as follows:—

I have carefully read the report of Mr. Evans upon the prospects of Cotton Growing in Fiji. I quite agree with his final conclusions. In the case of No. 7, very great care will have to be exercised to prevent mixture of seed or hybridisation if they plant shorter staple cotton with Sea Island.

I see he mentions the one case of a million acres. Of course any very large planting of Sea Island cotton at present in Fiji would only result in a glut, but I think from the report of the users of this growth which arrived this season, that a reasonable quantity would be freely taken by them at about the level of prices which we obtained. Stained cotton is worth about half the price of the sound. It is quite possible that Sakellarides Egyptian will continue to fall off in quality, and if such takes place in four or five years time large quantities of Sea Island cotton would be wanted.

If the price of American cotton fell the growth of this variety in Fiji might not be economical owing to the freight. I agree with him that the rainfall in some of the districts is rather too heavy for Sea Island. I notice that he suggests planting up the valleys where the Indians have settled, but he does not mention the distance from the coast. As you are aware the Sea Island always does best near the coast, and in Florida and Georgia the further inland it is planted the poorer the quality becomes.

With regard to the sugar plantations which he mentions; I presume that he is aware that in St. Kitts Sea Island cotton is successfully planted as a catch crop with sugar.

He mentions that at Vanualevu he had examined "stand over" plants, which, I presume, is ratooned cotton. This, of course, is wrong, and will deteriorate the quality of the growth.

In conclusion, in a letter to the Acting Superintendent of Agriculture summing up his views on the value to Fiji and to the Cotton Industry of the Colony, Mr. W. H. Himbury remarks:—

Mr. Thomas Horne of Fiji recently called here, when I had a long conversation with him with regard to cotton growing in your islands. Mr. Horne also left with me four samples of Sea Island and, we believe, Pima cotton. I carefully examined these samples and also submitted them to one of our expert brokers in Liverpool and for your information have pleasure in enclosing you a copy of their report and valuation.

Mr. Horne was also desirous that we should send out to you samples of West Indian Sea Island cotton and also a sample of the best Egyptian. These I have obtained and I am forwarding them to you direct under separate cover. I shall be obliged if you will kindly send a portion of these samples on to the Cotton Inspector at Lautoka, who has also written to us asking for a similar service.

So long as Fiji can produce cotton of a type equal to the A. and B. qualities, then we would recommend you to continue with the same, although it is important that you see that the quality does not deteriorate and that the same care is taken with the preparation, *i.e*, clean picking, careful ginning, and packing of the cotton.

I might add that I am also sending a copy of this correspondence to the Colonial Office, asking them to impress upon the local Government the importance of assisting, in every way possible, the promotion of this industry.

THE DANGER OF HYBRIDISING COTTON.

In one respect Sea Island cotton, the variety at present grown in Fiji, has not fulfilled the growers' "one bale of lint to one acre" dream that other types of cotton realise under climatic and other favourable conditions. The picking of the crop is a slow and costly operation and the weight of the crop is lighter than is the case with some varieties of shorter stapled cotton.

It is not a matter for astonishment therefore that the question of experimenting with a heavier yielding cotton and one easier to pick than is Sea Island should have been raised by the island cultivators who for the last two seasons have grown the cotton ginned in and shipped from Fiji.

They contend that the bolls are small and hard to pick clean, consisting mostly of three locks instead of four, and that a good day's picking does not exceed 30 to 40 lb, according to the density of the crop.

From quarters where cotton growing is not looked upon with favour, they have heard that Sea Island is a luxury trade cotton and that the market for that kind is limited and therefore sales will be uncertain.

For lack of proper cultivation and attention, the yield per acre of the first crop grown was much below what they had been led to anticipate. The island's average is still somewhat low although improving; it amounts this season to 424 lb of seed cotton, representing at the low extraction rate of 25 per cent. for this kind, 105 lb of lint per acre; yet, growers fail to realise that long staple, high priced cottons, are not so prolific as short stapled types. On the whole, local results do not compare unfavourably with other growers' experience.

The pressing request for a change of variety was mostly made before the price realised by the last crop shipped, viz., 25d. per pound, was known. Since then growers have looked on Sea Island cotton in a more favourable light, the prices realised surpassing their anticipation.

These questions were fully considered while Mr. G. Evans, the Director of Cotton Culture in Queensland, was here investigating the problems of Island Cotton Culture and as a result the declared policy of the Department of Agriculture has been to adhere to Sea Island cotton until such time as more is known of other kinds grown under local conditions. Certainly no alteration is contemplated in that policy unless with the full concurrence and on the advice of the British Cotton Growing Corporation and of the British

Cotton Growing Association who will be fully informed regarding the merits of any new kind tried from the colonial growers' point of view.

With the object of testing new kinds likely to give good results, small parcels of selected seeds were procured and are under trial, viz., 200 lb "Durango," a long staple upland from Queensland seed, and one quart parcel of "Meade" upland long staple from the Bureau of Plant Investigation, Washington; besides a plot or two of "Pima," an Egyptian and long staple American hybrid, locally tried last season. The Cotton Inspector in charge of operations is fully seized with the danger of hybridisation; half a dozen picked planters have been selected to carry out the variety test. All plants on the experimental plots, which are mapped out and kept under observation, are carefully controlled and will be uprooted and burned after the picking season. All packages containing seed cotton from these experimental plots will be properly marked and the seed after ginning will be destroyed, only seed from isolated plantations of pure Sea Island being distributed for planting. There is no occasion therefore for any concern regarding the danger of hybridisation of Fiji-grown cotton, provided the precautions as laid down are scrupulously carried out.

COTTON PICKING MACHINE.

For many years the inventive mind of the American manufacturers has been directed to the elaboration of an efficient and a reliable cotton picking machine, to replace hand picking which is gradually becoming more costly and is often unprocurable.

One of such machines worked on the suction principle has been tried out by a Toledo firm, the Banting Manufacturing Co. Each man controlling one of the aspiration tubes, places the aspirator on the ripe cotton boll, which is immediately sucked on and conveyed to the cleaning chamber.

The comb inside the suction tubes shuts out leaves and other foreign matter which would obstruct the passage or lower the grade of the cotton.

The machine and the whole mechanism are mounted on a motor chassis handled by one man, one gallon petrol is consumed per hour.

The machine picks over eight rows at a time, and during the tests produced 2,300 kilos of fibre in ten hours of work, one mechanic and eight collectors being employed.—*International Review of Science and Practice of Agriculture*, p. 425.

MEADE COTTON.

With the revival of cotton growing in the Colony it is evident that Fiji cotton must be placed on the market as a definite type.

To ensure that object, Government contro of alll cotton seed is an admitted necessity for maintaining purity, for regulating the time of planting, and for enforcing the rooting-out regulation as a check against pest.

The testing of new kinds is at the same time desirable as a means of comparison, provided it is carried out with sufficient care and attention and under a watchful supervision.

The successful cultivation of Sea Island cotton in Fiji has long been demonstrated, but this does not preclude the trial of other early maturing, long staple varieties of similar type, but with larger bolls, cheaper to pick.

Two such kinds are under trial this season: Pima, an Egyptian hybrid, which is being more critically tested this year than it was last season and is a promising kind from the cultural point of view, and Meade, a new

American variety, a small packet of seeds of which this Department was fortunate to procure direct from the Department of Agriculture, Washington.

From the same source a highly interesting Bulletin (No. 1030) has been issued on this new variety, from which the following information is taken.

Within the last few years the gradual encroachment of the Boll Weevil along the Atlantic seaboard has seriously threatened the Sea Island cotton districts, the large growth and the late maturity of the crop rendering that cotton particularly susceptible to the weevil.

Meade cotton, an early maturing, long staple Upland variety, has shown promise of success as a substitute for Sea Island cotton. It originated in North-eastern Texas, the fibre measures $1\frac{1}{2}$ to $1\frac{5}{8}$ inch with a slight range on either side and has the long silky appearance of Sea Island. The spinning tests approximate that of that long established variety as well as the market value. The seeds like Sea Island are naked, but have a small tuft of white fuzz at either end, they are brownish-black and larger; both should be ginned on the roller gin and not on the saw gin, which although quicker cuts the fibre. On account of the larger size of the seed the ginning of Meade is slower, unless a wider spaced seed grid is provided. Both kinds are also baled in the same manner and pressed with a lesser density to the cubic foot than is the practice with the coarser and shorter staple cottons, *i.e.*, 14 to 20 lb to the cubic foot.

The vegetative characters are more those of the Upland than of the Sea Island cotton. The shape of the plant and of the leaves, the earliness in fruiting and the size of the bolls are characters in common in Upland sorts. The fibre for length and fineness is classed with the Sea Island. As regards size, Meade is much the bigger, a large percentage of Sea Island bolls have only three locks, while most of the Meade bolls have four locks and a few have five locks.

The number of four-locked bolls of Meade to the lb is 69, and of Sea Island 126, which makes the cost of picking the bigger boll kind cheaper.

Cultivation of Meade Cotton.

The first essential is good and pure seed from plants that have been grown some distance away, at least 300 yards from other kinds of cotton.

The cotton pollen grains are sticky and are not carried by the wind, but insects act as carriers and therefore proper isolation is essential where two kinds of cotton are cultivated.

Uniform, equable conditions of growth are required, rather than over rank growth followed by stunted branches.

Before the flowering time the fields should be carefully inspected and all hybrids or off-type plants removed before cross pollenation can take place. Later on, all plants which do not conform to the Meade type should be destroyed to maintain uniformity.

Like all long staple cotton, the Meade variety must be picked with great care, the seed cotton being thoroughly and uniformly dried before ginning. A few weeks must elapse between picking and ginning, the fibre, it is contended, gaining meanwhile greater lustre and strength.

Like Sea Island, Meade cotton must be ginned on a roller gin.

By closer spacing, by chopping or hoeing a little later, the wood limbs are more or less suppressed, thus allowing more plants to stand in the rows without crowding and allowing more fruiting branches to develop and mature an earlier crop.

Thinning is deferred till the young plants are some 6 to 8 inches high, the central stalk thus grows straight, bearing numerous well developed fruiting branches and fewer vegetable branches or secondary stalks.

There may be less injurious crowding with only fruiting branches than with large spreading wood branches.

Selection Necessary to Maintain Uniformity.

However carefully selected the seeds may be, inferior plants will appear. If these are allowed to flower, bees and insects visiting the flowers will carry the pollen from the bad to the good plants.

To guard against this, selection must be continued to keep any variety from deterioration. It is bad policy to wait till the crop matures to rogue out the inferior plants. Even before flowering it is possible to distinguish "freak" plants by difference in their habits of growth or the characters of their stems and leaves. Whenever these are detected they should be pulled out at once. A second inspection of the crop should be done after the bolls begin to mature, when all plants with bolls showing a variation from the standard of the variety are also pulled out.

On the other hand, careful observers mark the seed and select individual plants, picking them separately in paper bags properly labelled, and at the proper season plant these in adjoining rows. It often happens that a very good plant produces a comparatively inferior progeny; these should be rejected as a whole and selection limited to the best rows.

This method however does not prevent cross pollination of the selected plants in the progeny rows, when these are not all of a uniform type. To guard against that, some seeds of the original plants are held over and those of the kind showing best in the progeny rows can be planted in an isolated breeding plot the year following the progeny test. These plots must be some distance away, about a quarter of a mile at least. In this way a special strain is developed from a single superior plant.

N.B.—No orders will be booked for next year's planting of the Meade cotton from the locally-grown seed, and it is proposed to take action against any infringement of this measure of precaution.

Samples of cotton from these seeds introduced will be submitted to the British Cotton Growing Association whose advice, after consultation with the Fine Cotton Spinners' and Doublers' Association, Limited, will guide future variety tests.

Should the variety meet with approval, fresh seeds will be procured, if possible, from official source and planted in isolated fields to guard against hybridisation.

DRYING AND BALING COPRA.

During his recent visit to England Major Willoughby-Tottenham, of "Devadara," Cakaudrove, on Vanualevu, took special interest in matters connected with the drying of copra and the packing of the manufactured article in the bales with the greatest density possible for freight. As a result of his investigations he has shipped to Fiji a Chula copra drying machine of the latest model, of medium size, suitable for 200 to 300 acre plantations.

It is proposed, after the copra comes out of the dehydrator, to run it through a Root slicer, which cuts it into slices of even thickness, preparatory to pressing, and thus ensures close packing without the harder pieces squeezing oil out of the rest. From the slicer the copra falls into a rectangular shaped cage of a Bijoli baling press, which is made for hand or power, where strips of hessian has previously been spread. The slicer and the press are worked by pulleys and belts from an overhead shaft connected with a five-horse power crude oil Petter engine. The plunger of the press descends at

a steady pace over the copra inside strips of hessian in the iron cage until the pressing is completed, when the press is opened and the copra is seen compressed into a rectangular form. The bale is then closed, strapped with wire, light wooden battens on the edges keeping the wire from cutting into the pressed mass. On examining the copra out of a bale which had been pressed some days before, no sign of oil was seen oozing out.

The bale which is made to fill the iron cage is 30 by 15 by 14 inches, and 11 of these go to the ship measurement of 40 cubic feet; each bale weighs 175 lb. as against 150 lb, which is the average weight of the ordinary sack of copra measuring 44 by 22·5 inches and going 10 to the ton measurement. The better pressing results therefore is a saving of freight on one bale, and with freight at 65s. a ton there is a saving therefore of one bale, viz., 175 lb, and the extra weight of 25 lb per bale on 11 bales, or 275 lb, representing altogether 4 cwt. more copra being shipped in the same space. With more practice it would be possible to speed up the baling process a little quicker than at the trial given at Messrs. Brown & Joske Limited shed on Nubukalou creek.

One bale out of the lot shipped to England has been kept back for inspection about the time the copra is expected to arrive at its destination.

THE ISLAND OF ROTUMA.

By M. A. Forsyth.

During a recent visit to Rotuma I had an opportunity of inspecting that island, which is of limited extent, of volcanic formation with sandy flats well suited to coconuts with which about two-thirds of its area is densely planted. Over two thousand tons of copra are exported annually but this does not represent full production. The quantity fed to pigs, together with that lost through the use of nuts for drinking purposes would bring the quantity produced to something very close to three thousand tons. The thinning of the groves would result in a further increase in the already heavy yield. On landing, one is immediately struck by the remarkably healthy appearance of the trees and by the immense heads of nuts they carry. Single spathes carrying over forty nuts were quite common. The average nuts are much larger than those of Fiji. There were some of exceptional size, obtained, I was informed, by removing most of the fibre from the vara when planting. Trees producing these did not carry loads. The most useful nut seen was one a little above the average size with very thin fibre and a large and heavily fleshed kernal. Trees carrying these bear prolifically.

There is an almost entire absence of disease on the Island. Leaf Miner (*Promecotheca reichei*) was present to a limited extent, heavily parasitised and to an even less extent the Leaf Eating Moth (*Agonoxena arguala*). There was also evidence of the presence of *Phasmidae* (stick insect) but damage was negligible. Two young trees showed signs of scale attack of recent date but the scale had entirely disappeared and I was unable to discover any specimens anywhere. The spathe borer so common and destructive in Fiji and the beetle borer (*Calandra taitensis*) were to my surprise entirely absent. This freedom from disease accounts for the heavy production of copra which must be at least three-quarters of a ton per acre. No attempt is made by the natives to keep their coconut areas free from undergrowth, but the Island is free from the noxious weeds of Fiji. In and around the town, large areas are enclosed by stone fences as pig paddocks.

These animals rooting for food keep these areas free from an overgrowth or weeds and scrub and to a certain extent manure the soil. The absence of insect pests is in my opinion attributable to the activity of bird life. There are thousands of small birds at all times during the day busily engaged among the coconut groves. One, locally named the "Aromea," appeared to me to be exclusively insectivorous and might be found suitable for importation to assist in dealing with *Levuana* moth. I had it under observation daily for some time and found it invariably flitting along coconut leaves obviously feeding on insects. It also appeared to collect such food from the spathe and from the bases of spathe and leaves. It is a small bird about the size of a robin with black and red plumage and a long bill. I am obtaining specimens for the purpose of identification. Its trapping and transport should be simple if it is found desirable to import it.

I saw headless trees here and there, the results of lightning or strong winds. The natives have the habit of cutting steps for the purpose of climbing to gather drinking nuts. It is a bad habit and while it apparently does not materially affect the bearing quality of the trees it weakens them, as will be realised if they have the misfortune to encounter a hurricane. The Island has been free from such visitation for over thirty years, but prior to that they were more or less frequent.

The method of preparing copra in practice there cannot be too strongly condemned. There is not only a big loss in weight but in quality through carelessness. Mostly the copra is cut irrespective of the weather and spread on the sand to dry. Practically no effort is made to protect it from the elements and when collecting it for sale sand and even small pieces of coral are included. The trading firms have made some effort towards improvement by erecting vatas where the native is allowed to dry his copra. I personally saw copra cut and packed in baskets for four days in the open with bad weather prevailing before being transported to the vatas for drying. The resulting quality was anything but desirable. I also saw some 700 tons shipped for America and while some of this was of excellent quality as a whole it was very low grade. The quantity of inferior quality included would cause further deterioration en route. The proportion of sand, dust, and rubbish was excessive. Regulations to ensure one good even grade of copra for export should be feasible and would be beneficial both to planter and trader and the Colony as a whole.

Bananas.

The quantity grown is negligible and only for food purposes. Cooking varieties and Javas predominate, there being very few of either Cavendish or Gros Michel. The borer (*Cosmopolites sordidus*) is prevalent and the introduction of the predaceous parasite would be welcomed.

Citrus Fruits.

Oranges and limes grow in profusion and are of excellent quality, except those of exceptional size which are dry and tasteless. I saw no signs of fruit fly or the brown moth so prevalent in Fiji.

Pineapples.

These are mostly of the large Queen, smooth leaf variety and grow well and appear clean and free from disease. They grow to an immense size but are very watery and lack flavour.

Other tropical fruits and vegetables grow well. At the Mission Station at Sumi grapes are successfully grown.

Stock.

There are very few cattle and there is little good grazing ground. The few that are there are dependent principally on bush shrubs for sustenance. There are a large number of undergrown and underfed horses mostly covered with Fiji sores. The native has no idea of the care of animals. The police should have power and be instructed to curtail the thoughtless cruelty practised there. Pigs are plentiful and enclosed in hugh stone-fenced paddocks and regularly hand fed, on copra principally.

The Island is I should say the richest in the Pacific but too small for extensive settlement.

PINEAPPLE FOR CANNING.

By A. Despeissis, M.R.A.C., Acting Superintendent of Agriculture.

Pineapples are found all over Fiji either wild along pathways in the scrub, or cultivated with more or less attention in native towns and gardens. They grow luxuriantly, both in the dry or the wet zone, where the rainfall ranges from 60 to 140 inches. Successful cultivation on commercial lines, however, requires attention to certain points briefly referred to in the following notes.

Climate.

Experience has shown that a mean annual temperature of 75° F. in the cool months to 85° F. in the warmer months, with a narrow range between day and night temperatures and with an average monthly rainfall ranging from 2 to 20 inches, favour best the continuous growth of the plant. It can indeed endure heavier rain provided the ground is never waterlogged. These are a shade above normal conditions in Fiji.

Good drainage is essential to healthy root growth and for that reason sloping land offers advantages not always found on flat land. Very fine pineapples grow even on steep slopes, but gently undulating land easy to cultivate cheapens cost of production and is therefore preferable. Hawaiian experience has demonstrated that under the conditions obtaining there, an altitude of 500 to 800 feet favours disease resistance as compared with pineapples grown at low altitudes.

To guard against land scour during heavy tropical rains, storm-water drains running as far as possible across the declivity of the land should be provided to carry away the rush of surface water. In fact, in a climate like that of Fiji thorough drainage is an important preliminary work to the lay out of a pineapple plantation.

Soil.

As the plant is intolerant of wet, retentive clay, a friable black or brown loam is the best, affording easy penetration of air into the soil round the roots, and at the same time capable of absorbing and of retaining moisture. Other soils though, such as the grey or the red soils, of which there are several types, grow good pineapples.

Certain soils have been found unsuitable, such as the black manganese soil of Hawaii or the lime-stone soils of Porto Rico, which cause iron starvation, characterised by a yellowing of the leaves and the development of undersized and acid fruit. A counteracting treatment consisting in spraying every few months a weak solution of sulphate of iron over the leaves is doing some good, but under Fijian conditions such a treatment is unnecessary for the reason that the trouble is non existent.

Where the desirable physical conditions are absent they can often be created by deep cultivation, by the addition of coral sand or the ploughing in of a cover crop of Mauritius beans or of Cow peas a few months before planting.

The use of artificial fertilisers, which is a *sine qua non* of heavy cropping in other lands, is not practised yet on the virgin lands of Fiji, where, from all appearance, the weight of the fruit is often in excess of that considered the most economical for the requirements of the cannery.

Cultivation.

Where manuring is not yet required, the benefit of cultivation is not to be denied. The native method of preparing the land answers in small parcels of picked land, but it does not lend itself to extensive cultivation. In the hand of the native the *doko*, which is the name of the stout pointed stick he uses, does good work. It is driven some 9 inches into the soil, in a slanting way, and while the top end is pressed down the pointed part in the ground heaves it up and leaves it in a loose and friable condition. Where a bigger area has to be stirred up, the operation is repeated from different angles around the same spot, finally the *doko* is driven straight into the centre of the loosened ground and with a rotary motion it leaves a circular hole of the depth and the size required, into which the seed or the plant is placed and then the ground is pressed and made firm around.

By this method, stumping of the bush land is not essential and ground too steep for ploughing can be cultivated. The subsequent work of weeding, however, is made more costly and, all conditions being equal, the advantage remains with the cultivated land when the crop comes to be harvested.

Where the land can be cleared with the fire stick, such as the rolling downs under tall reed grass of the dry zone or of the intermediate country between this and the forest land of the wet zone, very little stumping remains to be done. When cleared, the land can be ploughed and then harrowed and cross harrowed. After resting four or five weeks most of the roots and vegetable matter have more or less rotted, the same operation is renewed and the land is left in a loose and friable condition for laying out the lines and for planting. Land thus prepared will be less costly to keep clear of weeds and will hold moisture even during lengthy periods of dry weather.

The Smooth Leaf Cayenne is the kind canners in Hawaii have founded their great pineapple canning industry on and it is the kind therefore required for the proposed canneries in Fiji. This kind is also locally called, though incorrectly, the " Queen Pine " and sometimes the " Giant Kew."

The leaves are long, broad and smooth or with very few spines towards the tip, they are dark green in colour; the flowers are purple; fruit large to very large, weighing from 3 to 12 lb, pyramidal or cylindrical, dark orange yellow when ripe, flesh pale yellow; rich, well flavoured, pips large and flat. Does not sucker so freely as other varieties. The main crop ripens in the warmer months: October–February, with another shorter season in the cooler months: July–August. It is largely grown in the Azores for supplying the English market during the winter and early spring months.

The kind of pineapple most popular in Fiji for eating is at the present time the Ripley Queen. Unlike the Smooth Leaf Cayenne, it has spiney leaves, green with purplish longitudinal streaks running up the centre and becoming less distinct as the plants get older. This variety is smaller than the Smooth Leaf Cayenne, the flesh is of a light canary colour, juicy, sweet, and highly flavoured.

What to Plant.

The pineapple is seldom a seed carrier and this method of propagation is only used when new varieties are desired for testing "wilt" resistant varieties. A pineapple seedling takes several years to grow and mature its fruit, hence the quicker method is usually followed of propagation by means of suckers, gill sprouts, slips, and crowns.

Like the banana, the pineapple bears only once, the subsequent crops being carried by "suckers" which grow at the base of the mother plant, take root and bear fruit in the proper season. When clearing up the plantation after the fruiting season, the old plants are removed and if the suckers are too numerous they are thinned down to two. Some prefer to plant gill sprouts to suckers for the reason that suckers often carry fruit already in embryo when removed from the ground; this appearing before the sucker is properly established, often fails to come up to standard. This objection only applies to the first crop and not to the second crop from suckers grown *in situ*.

The "gill sprouts" are buds which shoot out from the stalk at the base of the leaves. Two, three, or more may grow on the one plant; they are pulled off if they are likely to interfere with the size of the fruit.

The "slips" are produced from buds on the fruit stalk, at the base of the fruit. They are smaller than the suckers and the gill sprouts, but are more abundant. If it is intended to use them for planting, all but two are rubbed off.

The "crown" is the cluster of short leaves on the top of the fruit; when required, they are collected at the cannery and may be used after the usual period of sun curing to dry up the flesh which would otherwise ferment in the ground and interfere with growth.

The "stumps" are occasionally used for planting and produce vigorous growth. It is the only portion of the pineapple plant in which starch is found stored up. They may be planted in holes like sugar-cane sets. The time between planting and the ripening of the fruit varies with the strength of the plant. Strong suckers bear within twelve months. If transplanted, like gill sprouts, the fruit may be cut in about fifteen to eighteen months. Slips generally take eighteen months, and crowns even longer.

Some preliminary preparation is required for healthy growth. Whether suckers, gill sprouts, slips or crowns are used, it is usual to expose the butt end to the sun for a few days to prevent bleeding and base rotting when they are put in the ground.

If mealy bugs are present at the base of the leaves it would be advisable to dip the butts into kerosene emulsion for a few minutes.

When plants are removed to the site of new plantation some distance away they are tied up into bundles of 25 or 30, all the tops pointing one way. They thus stand less risk of heating and fermenting than if packed in bags or in boxes.

At the time of drying the butts of the suckers in the sun and before planting, the small leaf scales at the base are pulled off to guard against what is known as ranglefoot. This enables the rootlets to strike out freely, as they sometimes twist round the base of the young plant and girdle it and choke its growth, when it becomes necessary to pull out the plant from the earth, cut the twisted roots and replant again.

Planting can be done at anytime under island conditions, provided the ground is moist enough, but summer and autumn planting during the rainy season is best, as the plant growth starts then and is not checked during the winter.

Spacing.

The number of plants required for an acre usually ranges from 3,000 to 7,000 according to kinds and the lay out of the ground. The experience gained is in favour of close planting, but provision must be made for the convenient working of the plantation; this consists mainly in maintaining it clean and in removing the crop which may be very heavy.

In Hawaii and in Queensland the double or the triple row system, with an interval of 6 feet between the rows, is preferred. The plants, about 5,000 to the acre, are set in alternate lines at intervals of 18 to 24 inches in the rows.

In Singapore the common plan is single rows five feet apart, with plants 2½ feet in the rows and a 6 feet path at every 100 feet. About 3,000 suckers are required to plant up an acre.

In Florida close planting in beds 12 to 15 feet wide with a pathway around is the practice generally followed. The distances between the plants being 20 by 20 inches for the smaller varieties up to 36 by 36 inches for the largest kinds. The plants are not always set out in squares, Smooth Cayenne, for instance, is often planted 20 by 30 inches apart.

This close planting fills the ground quicker, smothering the weeds, the plants support each other better and there is less sun scalding. On the other hand, a greater number of plants is required for a given area of land and horse cultivation becomes out of the question. The gathering of the fruit is more difficult, particularly the spiney leaf kinds, and the plantation requires systematic thinning out or else it becomes impenetrable.

Cultivation.

From the time of planting, clean weeding and the maintenance of a loose friable surface will help the plants along. When the spacing is wide enough to permit of horse cultivation, light scarifyers of the Planet Junior type will effect that work, with a little hand hoeing and hand weeding where the tools cannot be safely used. To obviate this weeding, locally made paper strips are used with advantage as a mulch in Hawaii, and tend in supressing weeds, conserving moisture and improving the size and quality of fruit suitable for canning. When ploughing is found necessary it should be to and not from the pines. In wet places more particularly, this will leave a shallow furrow which acting as a drain will save the roots of the plants rotting in waterlogged land.

Weedicides have lately been used with advantage in Hawaii, both in the cane fields or on pineapple plantations, but in inexperienced hands this may prove harmful.

As soon as the pineapples close together, the weeds are smothered out and the cultivation of the open spaces between the lines is all that need be done.

It is at this time that all superfluous gill sprouts and slips are removed, also old stumps which have already borne fruit. Only suckers growing out of the ground or ratoon suckers are left, not more than two to a plant; overcrowded beds produce mostly spindly suckers and low grade fruit.

At the same time any barren plants or suckers or crippled pines are pulled out and destroyed. A dark line showing on the underside of the leaf and running lengthwise generally indicates such undesirable suckers.

"Spiking," or pines with narrow leaves growing straight up, is an indication of weakened vitality and may be caused by insufficient cultivation, want of drainage or excessive acidity in the soil. Once the cause is corrected the effect disappears.

Harvest.

The main crop in Fiji ripens in the summer from November to January, with a slight variation in the range of the season, according to locality and the time of planting.

The Smooth Cayenne besides has a short season in the winter: July–August. The summer crop is the main crop and the more regular, producing a better flavoured fruit.

For shipping, the fruit is picked when fully developed and partly coloured, but before it is fully ripe. For local sale it is allowed to remain on the plant a little longer, until quite ripe, but it must be cut before it is dead ripe and before the flesh is likely to lose its firm texture during the process of canning and develop a winey flavour.

Unlike the banana, the apple or the pear, the sugar content of the pineapple does not increase after removal from the parent plant. The source of that sugar emanates from the stored up starch in the stump portion of the plant, so that when that source is cut off the supply ceases.

A pineapple cut on the green side, for shipment, continues to colour up but its sugar remains at 5 or 6 per cent. as it was at the time of cutting. By the time it is cut and ripe enough for eating straight or for the cannery, the sugar content has doubled and with the rise in sugar the flavour also increases.

This fact was illustrated last year when this Department shipped in cold storage to the Dominion Canners Ltd., Vancouver, a trial consignment of pineapples. They all carried well, but some cut on the green side and apparently ripe had not improved in sweetness and could not be compared for flavour with the rest cut at a more advanced stage of ripeness.

With the more general application of cold storage to the shipment of fruit, it will be possible to pick pineapples more fully ripe and supply distant markets with a sweeter fruit like that gathered for eating in the country of production.

Pineapples either for shipping or for canning should be cut from the plant an inch or two below the fruit and when ready for casing, a stump a inch long should be left on the stalk or else the core rots after a few days and the fruit is wasted.

For canning, fruit fully ripe and of the proper size, $3\frac{1}{2}$ to 7 lb, cylindrical rather than conical, are placed in strong crates or lug boxes where they carry without bruising to the cannery where they are put through the process within 24 to 48 hours from the time of cutting.

For the fresh fruit trade, the number of pineapples is indicated on the case. The consignment shipped to Canada, mentioned above, was packed in the flat Azores case, 40 inches by 21 inches by 8 inches outside measurement, with a centre board and open cleats for ventilation. The pineapples were packed in single layers twelve to sixteen in the case, the butt end pointing outwards; the temperature in the cool chamber was maintained at 50° to 55° F.

In Hawaii octagonal shaped crates are used, holding likewise about a dozen fruit each, the shape of the package ensuring ventilation all around.

The Smooth Leaf Cayenne is tender and difficult to pack. In Cuba, Florida, and Hawaii a large export trade has been worked up for the fancy trade, the fruit, weighing 8 to 10 pounds, being shipped in heavy paper cartons packed in crates and distributed to various parts of the United States.

Yield of Fruit.

Soil, climate, cultivation, and freedom from pests and diseases influence the yield. One fruit per plant will be produced for the first crop. Odd plants are barren but they are few and they can be weeded out. Under ordinary conditions therefore 4,500 to 5,500 fruit may be produced per acre planted at distance shown in the double and the single row systems. About 3,000 if planted as explained in Singapore and 6,000 or more if planted in beds, Florida fashion; after the first year they should produce an average of about two fruits to each original plant. The pineapples may not all be marketable or many may be spoilt by sunscald, through the depredation of rats or for some reason or other. In Singapore 6 to 12 tons per acre are gathered, in Hawaii 8 to 20 short tons and more, in Florida quite as much. The weight per acre has not been ascertained in Fiji, but if 4,000 to 8,000 pines averaging 4 lb each are picked, a crop of 7 to 14 long tons should be obtained without manuring as practised on old cultivated land.

Under the natural conditions obtaining in Fiji, admittedly favourable as they are, the length of time a pineapple crop takes before showing signs of declining has yet to be determined; without the stimulus of artificials, it is highly probable that three or four good crops may be expected, whereas with the right kind of fertilizers and with care and attention that time may be much extended before new fields freshly opened out replace the old ones. With home-grown suckers available for the labour of picking, the cost of a new plantation amounts to only half that of the initial plantation when suckers have to be bought. A renewal every few years or so is generally advisable to ensure a higher proportion of first class fruit.

PINEAPPLE GROWING AND CANNING INDUSTRY.

The question of the cultivation of pineapples for canning has for several years past engaged the interest of the public in Fiji.

A comparison of local natural conditions with those met with in other countries, where pineapple growing ranks as a lucrative industry, has led to preliminary tests being made, which have been most encouraging.

As a result of negotiations, following a visit of the Colonial Treasurer to Canada, a draft agreement has been prepared for a joint experiment on a small scale with the Dominion Canners Ltd., under which the Fiji Government provide the fruit required, and the Canadian Company preserve and market that fruit.

Object.

The object of the undertaking aimed at, is to provide a demonstration on industrial lines. The basis of the agreement is equal share in any profit or loss resulting from the operation.

The experiment, which will be judged on results, must naturally be conducted under conditions closely resembling operations worked out on industrial scales. The object of the Government is to prove, or the reverse, the prospects of the industry. It has no intention of itself entering into business.

The first essential is to provide the material for treatment. For this, small experimental plantations must be established to supply, in the first instance, the quantity of pineapples of the kind required by the canners, and for the distribution of sound suckers for future extension.

For the purpose of co-ordinating the operations of the growers, and those of the canners and distributors, of the finished article, a local Committee

has been appointed to carry out the recommendations of the Loan Committee, as broadly set out in a Memorandum submitted to the Legislative Council, and subsequently sanctioned by the Secretary of State. *

Factory.

It is proposed that the demonstration factory shall be located in close proximity to the wharf in Suva. The question of establishing factories nearer the centre of production being one which will be determined if the industry is launched and can take care of itself.

Consideration of freight on machinery and on material, convenience for handling, securing the right class of factory operators, and also efficient supervision, as well as providing facilities for as wide a public demonstration as possible, have influenced the selection of the initial site for the factory, which it is hoped will be run for two consecutive seasons.

Field Demonstration.

It has long been shown that splendid pineapples are grown on the slopes around Suva, where the area under that fruit has been greatly extended within the last two years. The practical field demonstration is almost complete there. Owing to a disease, suckers from this locality will not be available for planting in uninfected areas.

In other localities, on the two main islands, on Beqa, the Lau Group, Kadavu, and other islands of the group as far as Rotuma, several kinds of pineapples grow to perfection with little cultivation. One kind, in fact, which grows wild in small patches, is called the native pine.

The purpose of the Committee is to test in a practical way, such as any grower can apply to his own plantation, and without running to a high cost of production, several of the more accessible portions of the two main islands.

A site for an experimental plantation has been selected at Vitilevu Bay, on the border of the two well defined rain zones of Fiji. It was at first intended to use portion of a native reserve fronting a good anchorage in the bay, but it was, subsequently, found that this site could not be spared by the natives, and an adjoining site was offered, rent free, for the term of the experiment by the owner of Tova Estate. An examination of the land shows it to consist of a free, brown loam, with a good class of subsoil much of the same nature, but, naturally, not so rich in organic matter.† The land under reed grass rises in gradual slopes from 20 to 30 feet to about 300 feet above sea-level. A strip of 100 acres has been surveyed, of which 25 acres only are being planted for a start.

A sample of both the surface and of the subsoil has been handed to the Government Analyst, who will make a mechanical as well as a chemical analysis, and also, if found desirable, a determination of the manganese content for comparison with the manganiferous soil of Hawaii.

The accessibility of the site to the safe anchorage adjacent has also guided this choice. The cost of transport of a £5 per ton product, which must be put through at the factory within a day or two of cutting, is a limiting factor in the selection of a site for a plantation of pineapples.

The work of preparing the 25 acres, which, it is proposed, will be planted this year, as fast as suckers come in, is well in hand. The contractor—a local planter of experience—has all the necessary labour, horse power, and gear on the ground.

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* The Committee appointed by His Excellency the Acting Governor consists of: Sir J. M. Hedstrom, K.t., Mr. D. Lees of the Treasury, and Mr. A. Despeissis, Acting Superintendent of Agriculture, Chairman.

† The analysis of this soil and of the subsoil are given in this issue.—Editor.

To guard as much as possible against the introduction of diseases, the Government Mycologist has already started on an examination of the native plantations, where suckers may be secured for planting. The Ra and Macuata provinces on Vanualevu, where the bulk of the suckers will be drawn from, have already been inspected.

Smooth Cayenne only Required.

The planting is restricted to one kind only, the Smooth-leaf Cayenne, which is the pineapple favoured by canners in Hawaii. It is not meant to infer that the cannery will not treat the Ripley Queen, the kind more widely planted in Fiji. Of this kind there is already an ample quantity available, and the Committee will, therefore, concentrate on the Smooth Cayenne.

Planters' Co-operation.

The proposed nursery at Tova will be the only one under the Government's immediate control. Apart from the 25 acres it is proposed to plant this year, an additional 22 to 25 acres, which are already cultivated or about to be planted, in areas ranging from 1 to 5 acres, will be brought under the immediate supervision of the Government.

Besides this additional area, there are already growing in the vicinity of Suva, and within easy reach of the proposed cannery, some 25 to 30 acres of bearing pineapples, which will, no doubt, supply surplus fruit suitable for preserving.

The area planted in co-operation with the pineapple growing scheme is made up of plantations ranging from 1 to 5 acres, situated on Ovalau, Vanualevu, and Vitilevu, and will be subsidised under certain conditions by agreement with the Committee.

Briefly subject to approval of the draft agreement with the Dominion Canners Ltd.—the planter undertakes to bring his plantation under the operations of the scheme for two years from the time the cannery will start.

If the plantation is not yet started, he is empowered to procure from authorised sources sound suckers or slips of Smooth Cayenne for planting, at the rate of 5,000 to the acre. If an advance is made for the purchase, the cost will be deducted from the proceeds of sale of the fruit to the cannery, unless the Committee prefers to receive in exchange an equivalent number of plants for distribution to other intending planters, if required. The planter bears the cost of preparing the land, of planting and tending the crop, and delivering the fruit suitable for canning in crates loaned by the Committee for conveyance to the cannery, where £5 a ton will be paid for all suitable fruit. The best possible arrangement will be made by the Committee for transport from the time the cannery starts operations. It is expected that the cannery will receive pineapples as the crop ripens from October to the end of January, or possibly February.

The Committee's liability against total loss of crop through inability to start canning in October, 1926, or to make adequate transport arrangements for the carriage of the fruit is limited to £20 per acre.

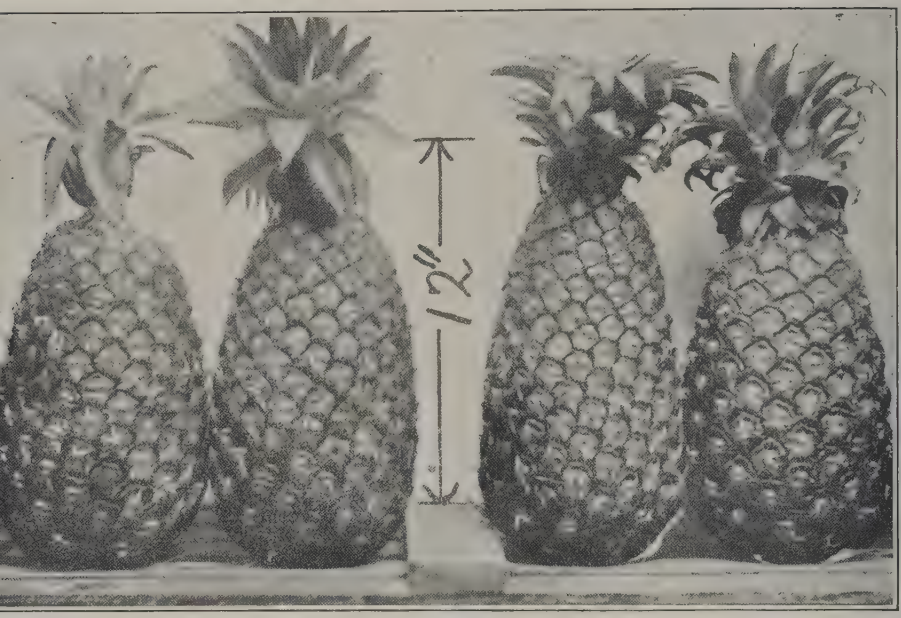
A word of caution may bear good fruit and save private planters including Fijian townsmen and Indian cultivators loss and disappointment.

It would be idle to foretell at this stage the permanent location of the future factory or factories, and it is therefore inadvisable to start planting without some reasonable assurance of being able to market the produce. There is also the risk of owners of plantations started indiscriminately and without supervision, being ordered to destroy their plantations should disease break out which it is intended to check. No assistance can be given at the start for transporting the fruit to the factory, as all the resources of the Committee will be centered on handling the fruit from plantations under their control.

PINEAPPLES BROUGHT TO THE PACKING STATION.

PACKING RIPLEY QUEEN PINEAPPLES FOR EXPORT.

(*For packing of Smooth Cayenne for export, see Vol.* 5, *No.* 1, *p.* 81.)



SMOOTH LEAF CAYENNE PINEAPPLES, VANUALEVU.

YOUNG PLANTATION: SMOOTH LEAF CAYENNE PINEAPPLES, SAMABULA.

PINEAPPLES FOR VANCOUVER.

In November last a cable was received from Vancouver asking this Department to arrange for a shipment of pineapples to arrive in Western Canada for the Christmas holidays.

Messrs. Brown & Joske undertook to take this matter up, and a fine consignment of mid-weight Smooth Cayenne pineapples from the Samabula plantation was shipped in cold storage by the s.s. "Niagara."

The pineapples, which were of fine and even size, averaged 6½ lb each and were carefully packed in single layers of ten to twelve fruit in flat cases, such as are used for export of pineapples from the Azores to London. They were in every respect treated like the consignment sent by this Department to the Dominion Canners, Limited, the season before, and referred to in the last issue of this *Circular*; the only difference being that they were picked on the green side to ensure safe carriage.

The following extract of a letter received by the Inspector of Produce from the Dominion Inspector at Vancouver carries a lesson which should be borne in mind when shipping further consignments of pineapples:—

> My reason for postponing my reply was in order to get a good chance to check up the ultimate condition of the pineapples shipped. Unfortunately they arrived entirely too green to give them a chance of ripening sufficiently for consumption. The grade was excellent and had they been shipped in a riper condition I imagine the quality would have been good, but it rotted before it was fit to use.
>
> I have in mind a shipment that arrived in Vancouver the year previous for the Dominion Canners, Ltd., Vancouver, from Suva, that was the finest I have seen imported into Vancouver, and my experience dates back some twenty years.*
>
> Under the circumstances I see no reason why the condition of the recent shipment should be discouraging. It is only a question of shipping at the proper time. Possibly the results would have been better had the shipment not been subjected to cold storage en route which might apply to fruit in a ripe condition but not so green as the ones that recently arrived.

It is a peculiarity with the pineapple that from the moment it is cut from the parent plant its sugar content remains the same, and therefore a pineapple, full grown but cut green, may on keeping assume the appearance of ripeness but will remain as sour as when cut.

Unlike bananas and other fruits containing starch and other carbohydrates, which on ripening are transformed into sugar, the pineapple has no starch or analagous substances in the fruit. All the starch, which is turned into sugar as the fruit ripens, comes from the accumulated stores carried in the stem and in the stump. While a full grown but green pineapple contains 4 to 6 per cent. of sugar, a ripe fruit will contain double that amount.

Since the economic application of cool storage to the carriage of fruit, the banana export trade from the American tropics to the big consuming cities has been gradually increasing. People who would not buy sour pineapples, cut green to ensure transportation, are now offered a riper and a sweeter fruit, full of juice and flavour and the demand has in consequence sprung up for a riper and better flavoured fruit.

A market offers for Fiji-grown pineapples in Western Canada; cool storage is now available on the Vancouver mail boats, and there is nothing to stop shipments going when buyers realise they can depend on getting ripe pineapples shipped in a satisfactory condition.

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* The illustration showing cased pineapples was taken at the time the shipment to Vancouver referred to was sent.—EDITOR.

SOILS FROM PINEAPPLE EXPERIMENTAL PLANTATION, TOVO ESTATE, VITILEVU BAY.

BEFORE proceeding with the planting of the site selected for planting pineapples for canning at Vitilevu Bay, samples were taken with an auger of the soil and of the subsoil and were submitted to the Government Chemist for both mechanical and chemical analysis.

The result is given below by Mr. Colin L. Southall:—

I received eight samples of soil from the Tova Estate adjoining the Fijian town of Navuni-ivi on Vitilevu Bay on the 3rd March, 1925. As the samples were taken from a small plot (25 acres), aliquot portions of each of the four soils were taken and mixed, the same being done with the four subsoils. The results of the chemical and mechanical analysis given below are obtained from the average samples thus prepared:—

MECHANICAL ANALYSIS.

	Soil, per cent.	*Subsoil*, per cent.
Moisture	12·5	12·7
Loss on ignition (organic matter and combined water)	11·6	9·2
Calcium carbonate	..	..
Fine gravel above 1 mm	0·4	1·3
Coarse sand 1–3·2 mm	7·0	14·1
Fine sand 0·2–0·04 mm	24·7	28·0
Silt 0·4–0·1 mm	16·9	13·9
Fine silt 0·01–0·002 mm	19·1	14·7
Clay below 0·002 mm	7·2	5·5
Stones above 3 mm	..	..

CHEMICAL ANALYSIS ON DRY BASIS.

	Soil, per cent.	*Subsoil*, per cent.
Organic matter and combined water	13·2	10·46
Nitrogen (total)	0·19	0·13
Alumina	22·88	24·24
Oxide of iron	10·46	10·63
Oxide of manganese	0·39	0·34
Lime	·21	0·23
Potash	0·34	..
Available potash	0·023	..
Phosphoric acid ($P_2 O_5$)	0·14	..
Available Phosphoric acid	0·004	..
Carbon dioxide	..	..
Reaction to litmus	Acid	Acid

The above figures show that there is no marked distinction between the soil and the subsoil, so that deep cultivation is to be recommended.

The mechanical analysis shows a fairly good soil, the chief danger being that as the amount of organic matter present becomes reduced the soil will cake badly. Addition of lime would not overcome this on account of the small percentage of clay present.

The results of the chemical analysis are upon the whole distinctly favourable. The percentage of potash is most satisfactory, particularly in regard to the fact that this element is generally considered as being of especial benefit to pineapples. Nitrogen is present in sufficient amount but the phosphoric acid is low. I hesitate to suggest the use of superphosphate as the soil has already a tendency towards acidity. Basic slag would probably be ideal, but in the absence of this I think it would be better to grow one crop, using no fertiliser, and then re-test the soil for phosphates.*

In regard to the manganese oxide† present I am unable to express my opinion as to the amount likely to prove harmful.

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* Instead of basic slag which is cheap in England, but much dearer here, on account of high shipping freight, the same result can be obtained by mixing superphosphate of lime with lime to form basic super, which is better suited for acid soils.—EDITOR.

† The amount of manganese which is low is about one-tenth of that in the manganiferous soils of Hawaii, where pineapple leaves turn yellow and the young fruit develops a pink colour long before ripening and remains acid and unpalatable unless the plants are sprayed with a weak solution of sulphate of iron.—EDITOR.

PEANUTS.

By A. Despeissis, M.R.A.C., Acting Superintendent of Agriculture.

Peanuts used to be grown extensively in Fiji for export to Australia where they were worth £15 to £18 a ton and were retailed at 3d. to 4d. a lb. Since then the high tariff wall the Commonwealth has raised against outside imports has discouraged the cultivation in Fiji of this and many other tropical products.

Two facts however are well established; the crop grows here readily and gives a plentiful yield, the demand for the nuts is world-wide and considerable; it not only fulfils oil requirements, but it is used principally among indigenous people as an article of food in its unmanufactured state. The crop is moreover a soil renovator; it is much planted in conjunction with cotton and it brings in a quick return when sown among coconut, citrus, and other trees.

It can be planted in Fiji at any time of the year, but the rainy summer months is generally the season preferred, while the harvest comes during the cool and dry months.

Soil.

A heavy wet soil does not suit the peanut which prefers a free soil with good natural drainage.

This is readily penetrated by the flowers which grow and mature their pods under the surface of the soil; hence it is called "Earth Nut," the specific name *Arachis hypogea* denoting the habit of digging under the surface of the ground. A free soil favours the harvesting or digging of the nuts.

As a rotation crop peanuts are particularly useful, as they add nitrogen to the soil, maintaining and enriching its fertility. In cotton fields, amongst young coconut trees and in plantations which are not expected to yield a return for some years, it provides a welcome source of revenue at a stage of the plantation when the outgoings are much greater than the returns.

The cultivation necessitated for putting in the crop, for maintaining it and taking it off keeps the ground in good heart and free of weeds. It should not follow a crop that has freshly been ploughed in, as this would result in many of the pods being lightly or poorly filled.

Seeds and Seeding.

Several varieties are cultivated: the creeping or running kinds and the straight or bunch varieties; the latter being easier to harvest as the nuts collect round the collar of the plant.

The seeds are planted either whole or shelled; in dry climates the unshelled nuts are sometimes soaked in water for a day or a day and a night, before planting, to hasten germination. Unshelled kernels are not soaked but those only are planted that have the red parchment covering intact. Instead of shelling, the nuts are sometimes broken in two, with the same result; shelled nuts coming up quicker than unshelled. As a deterrent against insects and other vermin, sprinkling the seed lightly with a solution of equal parts of Stockholm tar and of kerosene has given good results.

The spacing should be such that horse implements can be used between the lines; the smaller or bunch varieties such as the Spanish or Valencias requiring less room than the running or creeping kinds. The spacing therefore should be 2 ft. 6 ins. between the lines and 9 to 12 ins. in the rows for the bunch or upright varieties and 12 to 24 ins. for the creeper or running kinds, the seeds being planted by hand or with a special mechanical planter to a depth of 2 ins.

As the roots do not spread, fertilisers, when used, are applied in the drills with the seed on soil deeply worked and made friable.

With selected kernels used for seeds, about two bushels of 22 lb are used, or a little over 40 lb of whole nuts and 30 lb of shelled; the latter coming up quicker than the whole nuts, two seeds are pushed in at each space.

Cultivation.

Strictly speaking the fruit is not a nut, but a pod produced by an annual legume of the pea family. The blossoms produced at the axils of the leaves after setting are forced into the ground where they develop 1 to 3 ins. underneath.

In the tropics it is sown at any time provided the crop has the advantage of rain during the growing months and fine weather at harvest time. In Fiji a crop sown in February is harvested in May or June. Where large areas are cultivated it is advisable to sow at intervals to allow for continuous harvesting, as when over ripe the nuts are easily detached from the plant and if the weather keeps wet they may sprout again. The ground should have been well worked at intervals prior to seeding to destroy weeds; after seeding the Planet Junior is a convenient implement to run.

The bunch or upright varieties mature within four months and the larger and creeping kinds take about five months.

Cultivation should be fairly frequent where weeds have a tendency to grow and the land should be kept loose to conserve moisture and facilitate the penetration into the earth of the flowering organs.

As peanuts belong to the leguminous family which are nitrogen gatherers, they are not so much in want of nitrogen as they are of the phosphoric acid and of potash, the first nearly always and the latter where the soil is light and poorer in potash. In Fiji where the soil is generally very rich in potash, an addition of phosphates mixed with lime is more essential for the production of a heavy crop; absence of lime is often the cause of empty or unperfectly filled shells or " pops."

Harvesting.

When ripe, the tops begin to yellow and to fade, the pods are then full and the inside of the shell begins to colour.

If harvested too soon the proportion of " pops " is greater. The digging is done by hand, with a broad lined spading fork pushed underneath the plant which is then easily pulled out with all the nuts adhering. In large areas where the soil is friable and clean, a plough with the mould board removed may run deep enough to cut the tap root each side of the row. This should be done after the dew is off the leaves, the area lifted being only as much as can be handled at the time.

When wilted, the earth is shaken off the roots and the bunches are loosely stacked by hand round poles four or five feet high, driven into the ground in lines every ten to twelve rows. Short cross battens about three feet long are nailed crossways to these poles which support the heap with the nuts inward and the tops outward, where they will cure without heating, a crop of grass being placed on top to throw rain off.

After two weeks, the crop is dry enough to cart into the barn where it is still left attached to the vines for two or three weeks or else the nuts shrivel and heat.

Picking.

When sufficiently cured, the nuts are picked off the vines; when done by hand 60 lb is a fair day's work but this can only be done when labour is

very cheap. Beating the bunches across a frame with tightly drawn wires, or the edge of a board placed midway across a box, facilitates the operation, another method is to rub the whole plants over wire netting drawn tight and through which the nuts fall. Winnowing removes all trash and light pods and drying in the sun causes the stems and tails to break off when bagging.

Where large crops are grown all the threshing, winnowing, grading, and bagging can expeditiously be done by machinery.

The dried up stalks and leaves may be either ploughed in as manure or fed off to stock.

Yield.

According to the fertility of the soil, the weather conditions during growth and the spacing given to the crop, the yield varies from 900 to 2,000 lb per acre; 10 to 15 cwts. representing a fair average yield; the tops either as manure or fodder also adding to the value of the crop.

Varieties.

As already stated, some are bunchy or upright in growth and carry the nuts at the base of the stem, in a cluster; others are creeping or running and carry the nuts more or less scattered around the base, where the joints of the runners touch the ground, these are less easy to harvest. Some mature in 115 to 120 days, others take 150 days; some have a large and clear pod, others are smaller and reddish. All varieties do not bear alike, some yielding better than others.

The roasting trade prefers the large nut known as the " China," one of the creeping kind. The confectionery likes the white " Valencia," which is not so large but has almost as big a kernel; oil mills buy the Spanish, Valencia and others of that type which are rich in oil, and prolific; the nuts of these are becoming popular with the confectioners, owing to its flavour.

Diseases.

As to the crop, in a rotation it escapes many of the pests attacking other crops and also those few diseases of its own.

A mealy bug is sometimes noticed on its roots, some birds and also vermin do some damage. On sour and poor land, a leaf spot (*Cercospora sp.*) is noticed. If it is late in showing, the tops may be mowed and made into hay and most of the crop can still be garnered.

In Java and other islands, a slime mould disease has caused great losses.

To guard against the possibility of such introductions, it should be the policy of the Government to extend to imported seed nuts the restrictions wisely adopted for controlling the introduction of cotton seed.

It should be the function of the Agricultural Department to further improve the quality of the locally grown kinds, by selection in the field, of seeds showing production and resistance to disease, rather than import large quantities of foreign grown seed and thereby run the risk of introducing destructive pests from which the Colony is at present free.

Uses.

Apart from being a soil renovator, the peanut crop is turned to advantage in many ways.

The whole plant is used as stock food, particularly pig grazing. For that purpose the tops, particularly of the upright or bunch variety, are mown for hay or fed off green, being carted away when the pigs are turned in to root out the nuts. Whenever " topping off " the quality of the meat

which is rather soft is corrected by the addition of other food of a more starchy nature.

The tops can be fed off to stock fresh or can be cured into hay and possess a feeding value similar to lucerne and a palatibility exceeding lucerne; stock eat it greedily no matter how dry. As there is often some earth attached to the hay, it is desirable to throw it into a cradle, through which the earth falls.

For sale, as whole nuts for eating, there is a good local demand and a wider market in New Zealand and in Western Canada. Australia, which was at one time a large buyer, has now raised a high protective duty of 2d., 3d., and 4d. against imported nuts respectively from the United Kingdom, the British Colonies, and foreign countries.

Peanuts are used whole, roasted, or shelled; in confectionery the kernels are first blanched by removing the outer skin and degermed.

Oil mills of considerable importance extract the oil from the kernels. They are first crushed and cold pressed, yielding an almost colourless oil of pleasant taste and smell, which is used as an adulterant of olive or salad oil, and as an addition to margarine for which purpose large quantities are used.

The kernels contain 40 to 50 per cent. and the whole nuts about 32 to 35 per cent. of oil, easily extracted; the kernels yielding about 32 per cent. extraction. After the first pressing, the paste is sprinkled with water and pressed again cold, this second grade oil being used mostly for lighting. A third grade oil is next extracted by steaming and is in great demand for soap making. Lastly, the residual cake still with about 8 per cent. oil left constitutes excellent food for stock, being palatable, high in protein or flesh formers, in starchy and in sugary matters.

As a manure the pressed meal is also valuable, as it contains as much as 8 per cent. of nitrogen, as is the case with copra.

Marketing.

The area suitable for peanut cultivation is more extensive than that for the coconut palm and is found in all countries possessing a warm climate and a sufficient rainfall in the summer or growing months, followed by a drier period during the harvesting months.

An extensive export trade in peanuts is done in India, China, Dutch East Indies, British and French West Africa, and the United States of America.

A rough estimate made by the International Institute of Agriculture, Rome, gives the world's yield of peanuts or ground nuts, either consumed locally or exported, as three million tons. When compared with the total production of coconut palm and taking 2·5 acres of coconut palm to provide one ton of copra, the world's product from the estimated area under coconut palm would be two million tons, only a portion of this of course being pressed for oil.

It is therefore realised that the cultivation of a few additional thousand acres of peanuts in Fiji would not have the least influence in upsetting the world's market.

The price of both peanuts or ground nuts is subject to some fluctuations. The many uses they are required for, the ease with which they are transported and stored explain the growing demand which has a steadying effect on the market.

For unshelled undecorticated peanuts oil mills pay £17 to £20 a ton and £20 a ton for the decorticated nuts.

Peanut oil is quoted at £40 to £50 per ton and peanut or ground nut cake at £8 to £10 per ton.

For confectionery and for eating as whole nuts, the market shows greater fluctuations.

From information supplied by H.M. Trade Commissioner, New Zealand imports about 390 tons. The Chinese peanuts in shell of the grade termed "hand picked," selected, which is the usual grade imported, have been selling at an average rate c.i.f. for the past four years (1921–24) at 48s. 6d., 43s., 36s., and 34s. per cwt., freight reduction having influenced prices current as compared with previous years. At the same time Chinese peanuts, shelled, were landed in New Zealand at the same price as the "unshelled" nuts, the average price c.i.f. being 38s. per cwt., twenty-three bags of 103 lb gross going to the ton.

The Java peanuts are imported decorticated and are considered superior to the Chinese kernel; on account of its darker shell and appearance the Java peanuts in shell are not popular. They are packed in gunni or hessian bags of 136 lb nett.

The quantity of the imported article is dependable and always new crop and fair average quality of the season's type. There is a growing demand for such products as "Peanut butter" and "Peanut oil," the former becoming quite a popular edible commodity. As the demand increases, it is anticipated that local manufacturers will manufacture in New Zealand, a fact which would stimulate the demand for the peanuts themselves.

Inquiries from Vancouver regarding the prospect of Fiji supplying a portion of the demand for peanuts elicited the following information from Messrs. Stevens Baker & Co., Ltd., of that city:—

Imports into Canada by way of this port, also into Eastern Canada, are by way of the Panama and will probably total somewhere in the neighbourhood of 3,000 to 4,000 tons and mostla brought into the Colony from November to March and April.

Peanuts in the *shell* are graded as to units to the ounce around approximately large sizes, such as 11–12 nuts to the ounce and decreasing in size to 15 nuts to the ounce.

The shelled peanuts usually demanded in our market run to the following sizes: 28–30 nuts to the ounce, 30–32 nuts to the ounce, 38–40 nuts to the ounce.

The usual packing required is in double bags and which contain 100 lb nett.

The average prices being paid this year are approximately, $4.50 per 100 lb on the larger size nuts in the shell and around $3.75 on the smaller sizes (£20 per ton of 2,000 lb). The shelled nuts have averaged about $5.50 on the larger size. These prices are c.i.f. Vancouver.

Peanuts are brought from either Japan or China. When in the shell they are either washed or bleached and graded as to size when designated so many nuts to the ounce.

Shelled peanuts are also brought in graded so many nuts to the ounce.

India is the largest producer of supplies. Two-thirds of the nuts exported were shipped to the oil mills in France, but since the war Hull has captured some of the trade.

The average f.o.b. value in India per ton was in 1904–5, £7 10s.; 1913–15, £11 14s.

The area under cultivation in 1916–17 was 2,317,000 acres, having gradually recovered from a reduced area of 94,000 acres in 1891, the result of the ravages of disease in the indigenous variety of nut in general cultivation. Seeds brought from Senegal and eventually from Mozambique have since restored the industry, eventually replacing the orginal plant. The imported kind it is found is more disease resistant, matures within a shorter period, yields a heavier crop and contains a larger precentage of oil.

Undecorticated nuts give better grades of oil than from nuts shipped decorticated and although freight is higher there is less spoilage during the voyage. Improved shelling machines and the application of a refining process, whereby even heated kernels are made to yield edible oils have extended the practice of shipping decorticated nuts.

KAVA OR YAGONA.

By A. Despeissis, M.R.A.C., Acting Superintendent of Agriculture.

The plant occupies an important place in the social life of many Pacific Islanders and particularly the Polynesians; among the Melanesians it is not so widely known.

Although a shrub, it belongs botanically to the peppers. The flowers consist of catkins while the berries are not unlike small pepper corn. The cultivated kind referred to in these notes seldom reaches the flowering stage during the space of its economic life, but other wild varieties flower and seed more freely.

The scientific name is Piper or as often *Macropiper methysticum* on account of its larger size.

The islanders know it as " Ava " in Samoa, " Kava " in other parts and in Fiji as " Yagona " (pronounced Yangona).

The plant does not do equally well everywhere. Small plantations or patches are seen throughout the group near most villages on the windward or wet zone of the islands and only in naturally moist places on the leeside. A naturally well-drained soil is essential, the richer the better; in Vitilevu, Kadavu, and Beqa, Yagona growing on the rich slopes at a height of 500 to 1,000 feet is specially prized for quality.

Propagation.

It is usual to plant short cuttings, and for that purpose the young wood towards the top of the wavy, knotted stems is preferred. These cuttings consist of two joints and are cut within a short distance of the eye, about half an inch from the buds; when the internode is cut long a shrinking takes place and moulds may penetrate the tender wood and destroy the bud.

Planting may take place at any time provided the ground be fairly moist. The cuttings are planted straight out, two or three in each hole, while a nursery bed is also prepared for supplies in the event of some cuttings missing.

For convenience for working on well laid out plantations, the plants are set in lines, the spacing in rich land being 9 to 10 feet apart or at the rate of 537 to 435 to the acre. On medium or shallow land overlying soapstone or lava tuff, the distance may be shorter, *i.e*, 7 to 8 feet or 889 to 680 to the acre. If planted on the septuple system or plants alternating in each line, an allowance of 15 per cent. more plants to the acre is made.

The Fijians with their pointed sticks or doko, dig holes at least 2 feet square and 1 foot deep, but on larger plantations and where the plough may be used, the whole ground can be ploughed and harrowed. It is essential that weeds be checked. The Yagona is a potash loving plant and it is therefore the practice to add ashes to these holes. It may incidentally be mentioned that besides the climatic conditions which in the wet zone suit the Yagona admirably, the soils of Fiji are notably rich in potash

Varieties.

Of the kind used for the preparation of the national beverage, several varieties are known in Fiji; they are distinguished by the height of the entire plant, the length and thickness of the joints and the more or less purplish or greenish tinge of the stems and leaves. Thus the dark red stem variety is the Yagona *damu*, the green is the Yagona *drokadroka*, the smaller green, with short jointed stems, the Yagona *leka*.

The shrub under favourable conditions is a quick grower and responds well to attention as regards cultivation. The stems are very brittle and

liable to snap when rubbed by chains and implements, while high wind and hurricanes also do damage.

From the roots, which grow thicker with age, several erect stems spring up; they are knotted at the joints and thicker at the base; the leaves are large, heart shaped or cordate, disposed alternately on the stalks, and either green or more or less tinged with purple. The clump reaches four or six feet in height and the stems from one inch to one and a half inches in diameter.

When clean cultivation and suitable conditions have favoured growth, the largest clumps can be grubbed out after three years from planting and the more backward ones allowed longer to develope. Very large size clumps take three or four men to carry, but clumps weighing 40 to 50 lb of usable roots and thickened stems are common, which when dry would represent 15 to 20 lb of an article worth 2s. a lb.

Uses and Abuse.

The thickened roots and butts of stems are preferred fresh, when they are pounded into a pulp mixed with the proper quantity of water, strained and drunk out of coconut bowls. A large quantity however is chopped into small chunks, sundried, bagged, stored and used as required.

The stores grind dried up Yagona and retail it in sixpenny or shilling packets of three to six ounces, sufficient for preparing one or two gallons of a light beverage, although some prefer it stronger.

This operation is performed with a requisite amount of pomp and ceremony, the mixture, either freshly pounded paste or ground dry stuff, is made in a *tanoa* or capacious shallow wooden bowl, standing on short legs and made out of the *Vesi* wood (*Afselia bijuga*), which is said to be almost indestructible and is one of the most valuable woods in Fiji.

The old fashion method of having the root masticated by young people, possessed of a sound mouth is not followed in modern day Fiji, the practice having been discarded for obvious hygenic reasons.

The emulsion which looks like weak coffee and milk, has a dulling effect on the nervous centres of those addicted to the beverage when it produces mild narcotic effects. When freshly made it possesses no intoxicating property, the partaker does not become quarrelsome, but enjoys a state of placid tranquility which may even, in the case of habitual dopers, interfere with the free use of their legs. Taken in excess, it produces a drying of the skin and dulls the eyesight.

True Yagona, rightly prepared, leaves a cleansing feeling on the palate and is considered wholesome. The spurious article made of other kinds or, it is said, of the same kind, grown in other groups, under less favourable conditions, more nearly approach soap suds in taste and appearance and is said to leave a headache when partaken of liberally. It is possible that this may be due to the practice of some traders of bleaching the dry root for export by exposure to sulphurous fumes in order to obtain uniformity of colour and an attractive appearance.

It is the practice in the islands when clenching a bargain or engaging men for work to give and take a small consideration, which often with the natives is called a "Yagona," and either consists of some Kava root or any other article that may be acceptable.

Medicinally, Yagona has not received from the medical faculty the attention it seems to deserve.

Analysis of the roots and thickened stems in a dry state show: cellulose 26 per cent., starchy matters 49 per cent., gums 6 per cent., some

balsamic resinous bodies and active principles named kawin and methysticine 3 per cent., mineral ashes 1 per cent., and moisture 15 per cent.

Apart from the position Yagona occupies in the public and social life of the natives and the acquired taste which have won for it many devotees, the plant possesses medicinal properties long recognised.

It is in moderate quantity stimulating like coffee, clears the head, producing what has been called Kaviac stimulation, allays thirst, stimulates salivation and perspiration and is said to affect the kidneys favourably, soothing inflammatory conditions.

It is as powerful in its therapeutic action as cubebs and copaiba, and also acts like a bitter tonic, increasing the appetite and giving tone to the digestive organs, in this respect acting differently from these drugs. It is said to act as a prophylactic to catarrhal affection of the upper digestive canals and it has the advantage over similar remedies of having an agreeable taste

A writer in the *British Medical Journal* remarks concerning the drug that it has a marked action in reducing the acidity of the urine and that it may be given with benefit in cases where there is an uric acid predisposition.

In the *Practitioner* for March, 1882, Dr. Leighton Kesteven, Colonial Medical Officer, Levuka, Fiji, contributes an interesting article on the physiological action of Kava or Yagona and his experience concords with that of the authorities mentioned as regards the marked property of the drug in its action on the genito-urinary tracts, controlling pain during micturation and suppressing the muco-purulent discharge from the urethro-vesical mucous membrane.

On the authority of Thomas Christie's " New Commercial Plant," No. 7, 1884, the root is largely used in Russia and is worthy of more attention. From what source it was imported, there is no mention made.

The fact remains that a drug capable of imparting an acquired taste and possessing mildly stimulating and pronounced therapeutic properties as does *Piper methysticum*, deserves attention.

With the general tendency to regulate the consumption of alcohol to a vanishing point, there are possibilities in the direction of introducing and popularising Kava or Yagona in the large populous countries of the world. Scientific Congress, Laboratory Research Institutes and Trade Journals are fitting platforms for proclaiming the virtues of this stimulating and beneficial plant of the Pacific. Once introduced to the outer world and a sound demand created, it may be left to the imagination to contemplate the influence the cultivation of the shrub would have in opening up the tens of thousands of heavy wooded mountain sides at present left untouched in the wet zone of Fiji.

The plant is not attacked by many pests. The *Aspidiotus destructor* scale, once common on the coconut, the Kavika and other plants, finds a suitable host on Yagona, but the introduction of internal parasites and that of the predaceous ladybird have created an efficient check on that pest.

At present there is not much traffic in interisland exchange in Kava. Within the last few years customs returns record on two occasions importations of the dried root, viz.: in 1918, 104,744 lb, worth £4,396 or 10d. a lb; and in 1923, 36,707 lb, worth £1,095 at about approximately the same declared value. The goods had an attractive light colour, but partakers declare an unpleasant after taste aggravated by a headache, due possibly to an overdose of sulphurous fumes used for bleaching.

* B. Seemann, " Flora Vitiensis." Dr. A. Fluesburg, " Therapeutic Gazette," 1883, p. 139. Dr. Dupuy, " La Tribune Medicale."

The roots meet with a ready sale locally and at present there is none offering for export. The local consumption is more then maintaining itself, and it is even said to be increasing, since so many Indians are developing the habit of Yagona drinking. Those owning patches of the plant make at times considerable profit out of the sale of the roots.

The undeveloped market does not justify at present extensive planting, although small areas cultivated under favourable conditions show highly remunerative returns.

MATE OR PARAGUAY TEA.

An inquiry made by Mr. James Harper of Taveuni respecting the shrub producing this well-known beverage, led to the following information being given:—

I am communicating with the Secretary of the Auckland Acclimatisation Society to see whether it will be possible to procure some seed or some fresh cuttings from that source of Yerba Maté (*Ilex paraguensis*).

The shrub is well known and grown in every garden in Mauritius where, before tea became more largely consumed, it took the place of that infusion, being both pleasantly aromatic and also invigorating on account of the coffee it contains.

I have no notes regarding the present commercial value of the dessicated leaves, but in the Southern States of America it is the object of a large trade.

Baron Von Mueller as far back as 1885 refers to the extensive use of this herb in its native country and other countries of South America.

In 1871 the province of Panama alone exported 3,600,000 lb, besides the 9,000,000 lb consumed locally, while in Rio Gande de Sul the local provincial consumption is nearly four times as much, not counting large quantities consumed by the aboriginal race. It was then much cheaper than coffee or tea (about 5d. per pound), but an individual there uses about 1 lb per week.

The leaves are prepared by drying, the branches being cut off and placed on poles over a wood fire. When dry and crisp they are beaten off on a hard floor, with a stick, the broken leaves and the powder being then made up into packages for keeping until used. During this process the aroma is developed. The chemical principles, caffein and a peculiar tannic acid, impart to it a pleasant aromatic odour and a slight bitterish taste. The infusion is made like tea by adding hot water over a small quantity of the leaves, it is both refreshing and restorative. Those who take to it are said to find it difficult to leave it off.

Besides the principles mentioned above Yerba Mate contains a volatile oil, to which its peculiar and pleasant aroma is due, and about ten per cent. of nutritius gluten, only a small portion of which dissolves in the infusion, but the benefit of which is obtained only when the leaf is afterwards chewed as is sometimes done by the natives. The leaves are said to bear steeping twice or even three times; they are certainly easier to cure than is tea; they are also quicker picked and the plant accommodates itself to a wider range of climate and of soil.

BANANA DISEASES IN VITILEVU.

By J. G. C. Campbell, B.Sc., Mycologist.

The Mycologist's report gives an outline of the work in hand as far as it has gone. Measures are being taken by the Department to control the spread of diseases from affected to clean areas and also for cleaning up abandoned and neglected plantations. Several of these diseases, the so-called Sigatoka disease in particular, are confined and localised to portions of the main and one or two of the adjoining islands and a pathological survey will soon be conducted to ascertain which of the banana producing islands of the group are at present free.—Editor.

The following report gives the results obtained after six months investigation into the diseases of the banana in Vitilevu. A great part of this time has been taken up with the organisation of the branch, and a certain amount of routine work and, during the earlier part of the time, the work was hampered through unfamiliarity with local conditions.

Visits have been made to various parts of the island where the plantations were inspected, and the material collected on these trips has been examined in the laboratory. The following tours have been made:—

Upper Sigatoka as far as Nalebaleba, Lautoka, Ba, Ellington, Nanukuloa, and Tova Estate.

Upper Rewa (Muananuku and Nasoli plantations), and the Wainimala River as far as Korosuli.

Lower Rewa (plantations of Messrs. J. L. Hunt, A. H. Witherow, and L. C. Bean), and Verata island.

Plantations at Lami, Colo-i-Suva Road, and Rewa Road, and in the immediate vicinity of Suva.

The various packing stations on the Rewa were visited and visits were made to the wharf to watch the arrival of the cased fruit and its loading into the s.s. " Tofua " for Auckland.

Diseases.

There are a number of pathological conditions to be seen in the bananas in Vitilevu. These may be dealt with under two headings, namely, (*a*) the non-parasitic diseases, due to the conditions under which the plant is growing, and (*b*) the parasitic diseases, due to the presence of some specific organism.

(*a*) Non-parasitic Diseases.

The principal of these is lack of drainage, especially on the plantations along the river where the bananas are planted on the bilo land. The soil in these areas is of a very close, retentive nature, and would require a very thorough drainage system. With the water-logged condition of the soil go sourness and lack of aeration, both of which are directly inimical to the plant, and indirectly, by interfering with the activities of nitrifying and other useful bacteria in the soil. The direct injury to the plant is indicated by the condition of the roots. These are stunted, and a large percentage are browned and rotten. In very few cases has a normal, well-developed root system been seen, and then only where the plants were growing in a lighter soil which was, naturally, well drained.

The method of dealing with this trouble is a problem for a soil chemist, who could determine the exact requirements after making physical and chemical analyses of the soils. It is suggested, however, that heavy liming with quicklime, the growing and ploughing in of leguminous cover crops, and, of course, the digging of suitable drains would ameliorate the trouble. Liming with carbonate of lime would need to be repeated at intervals during the growth of the crop, as, with the heavy rainfall, the lime would soon be washed out as bicarbonate. There is a wide field here in which planters might experiment for themselves.

The use of fertilisers does not appear to be resorted to to the extent to which one might expect. This again, however, is rather a problem for the chemist and the planter himself.

In the locality of Suva, and on the Rewa Road, plantations have been seen in which the bananas have been planted in soil less than a couple of feet deep and overlying solid soapstone. Such ground is obviously unsuitable for bananas and the remarkable point is that they ever bear marketable fruit.

(*b*) Parasitic Diseases.

Sigatoka Disease.—This is by far the most important of the banana diseases of Fiji. There appears to be doubt in the minds of some as to the identity of the disease, these maintaining that the disease which is now so

prevalent among the bananas here is distinct from that which broke out in the Sigatoka district in 1913.

Some material was found in the Department labelled "Sigatoka" in Mr. Knowles writing. This was found to have the same appearance as the diseased bananas have now, and the descriptions of the disease, as given in various reports, correspond with those observed now.

The symptoms of the disease are obscured by other conditions, *e.g.*, lack of drainage and cultivation, beetle borer and other leaf spots.

The symptoms of the disease as seen in the field are as follows: The first signs are on the lower leaves, which become speckled in patches with little brown dots. These enlarge, forming brown patches of dead tissue which eventually involve the whole leaf. The midrib turns yellow, the coloration eventually extending to the junction of the leaf stalk with the pseudostem. At this spot the leaf breaks down and hangs by the side of the stem. A bunch might be thrown, but it is often small and ripens prematurely. As time progresses, the rot extends into the top of the pseudostem and, probably owing to infection with secondary organisms, the decaying part has a most offensive smell. In milder cases the leaf destruction is not so rapid, and the plant might produce an apparently healthy bunch. Usually, however, the fingers fail to fill, and have an abnormal, rubber-like elasticity, instead of being brittle, as in the normal finger. Older fingers, externally still immature, on being broken across, show a creamy, or even pink coloration, not unlike the colour of ripe fruit, but the flesh, instead of being soft and sweet, is hard and rather acrid. Fruit in this condition does not appear to carry well and ripens very rapidly after picking. The roots in all the plants examined have been more or less decayed and of a reddish brown colour. This, however, might easily be due to bad soil conditions. The root system is in no case well developed.

Internally, the symptoms are indefinite and might be due to other causes. The vascular bundles of the corm are brown, and brown streaks here and there in the pseudostem and leaf stalks, and in the stalks and skin of the fruit, indicate the passage of the bundles in the aerial parts of the plant. The browning of the corm occurs also in bunchy top, and this might account for its presence in plants affected with Sigatoka disease, as many of these show, in addition, symptoms of bunchy top.

Under the microscope, no fungus nor other organism has been detected in the discoloured vascular bundles. Cultures have been made from various parts of the diseased plants. From the corm, bacteria and a fungus have been isolated. The latter was a *Gleosporium* similar to that found in fruit affected with anthracnose. In the leaves, bacteria and the same fungus were found. These various organisms are being reserved for infection experiments, as no definite announcement can be made until the suspected organism has been made to reproduce the disease in a healthy plant, and has been subsequently re-isolated and identified with the original.*

All commercial varieties seem to be susceptible. The disease is said to have commenced originally in the Sigatoka distict on Gros Michel bananas, and to have spread from there to the Navua River, the Waimanu and Lower Rewa; from there extending in both directions till practically the whole of the Rewa and its tributaries, the Waidina, Wainimala and Wainibuka, have become affected. The disease has been seen as far around as Vitilevu Bay and it is reported to be present to a slight extent on Vanualevu and possibly Kadavu.

* All attempts made to reproduce the disease with cultures of the *Gleosporium* have resulted in failure.

It is now rather a rare thing to see a Gros Michel. The Cavendish and the China vimama are both more or less seriously attacked. It has been seen also on the Sawaqa (*Musa fehi*).

No definite methods of control can, at present, be suggested, but *the following recommendations* should, if carried out, do much to keep the disease in check:—

1. Attention to drainage, manuring, and cultivation.
2. Collection and burning of all dead and dying plants and leaves.
3. The eradication of all abandoned and non-commercial plantations and patches of bananas.
4. The registration and periodical inspection of those which remain.
5. The prohibition of the transport of banana leaves as packing or protection of cargo in cutters, &c.
6. The prohibition of the exportation from Vitilevu to any other island of the group, of any plant, or part of a plant of the genus *Musa*.
7. Rotation of banana crops, allowing the present ground to rest for a period of, say, five years before replanting.

Bunchy Top.—This disease, the cause of which is unknown, is widespread in Vitilevu. Particular attention has been paid to it during the past few weeks while visiting plantations with Mr. Collard, of Queensland, who was here in connection with the investigations of the Commonwealth Bunchy Top Committee. Although the disease is not present in its virulent form, as it was in the last decade of last century, and is now in Queensland, it is distributed in a minor form, and a fair percentage of the plants seen exhibit symptoms of the disease. The disease, at present, however, may be regarded as one of the minor ailments of the banana. It is a *potential source of trouble* but, now, is not nearly as serious as Sigatoka disease and the beetle borer.

It appears that the disease is familiar to planters only as "cabbage top," "bunchy top," or "curly leaf," as it is variously called. Therefore, the general symptoms of the disease, as it appears here, are given.

The most constant feature of the disease is the presence of dark green streaks on the leaves, occurring between, and running parallel with the veins. They are seen most easily when the leaf is held up so that the light passes through it. These streakings occur at times also on the midrib and leaf stalk. Usually, it is most marked on the younger leaves. Affected leaves are more or less brittle and break readily on being squeezed in the hand. The main veins of the leaves are often thickened, giving the leaf a corrugated appearance. The leaves are bunched together at the head of the plant instead of coming out at more or less regular intervals, and the stem may be shortened. Both of these last conditions are well marked in the typical "curly leaf" plants.

The most susceptible variety is the Cavendish, although the symptoms have been noticed also in the other commercial varieties and in the Sawaqa.

As yet, no method has been discovered of controlling the disease, and, therefore, no recommendations can be made. As the disease is at present being inquired into in a very thorough manner by a specially appointed group of scientists in Queensland, it is suggested that this Department should offer to co-operate in the investigations. With such a small staff in the Mycological Division here, it is impossible to investigate thoroughly every disease present in the banana—not to mention those occurring in other plants—and, as Fiji will benefit by any discoveries made by the Australian workers, it is but fair to render them very assistance possible.

Other Leaf Diseases.—Two apparently different leaf spots occur, both of which appear to be distinct from that caused by Sigatoka disease.

1. The first spot occurs as a small, dark spot on the veins of the leaves. It gradually becomes longer, and the centre turns a greyish white. The more mature spots are white and elongate, on, and parallel to the leaf veins. Their average size is 10 mm. by 2 mm. They are surrounded by a narrow, well-defined, dark brown border. These spots, individually, do not appear to attain any large size, although, when numerous, they cause severe destruction of the leaf tissue.

Cultures made from the spots have given, on almost every occasion, a growth of the *Gleosporium* previously mentioned, sometimes accompanied by bacteria. In some specimens, minute black pycnidia were seen on the surface of the white centre; these contained spores morphologically indistinguishable from those of *Cercospora musæ*, Mass., the fungus which was considered by Knowles to be the cause of Sigatoka disease. Attempts to isolate this fungus have, so far, proved unsuccessful. Experiments are now in progress to test the pathenogenicity of the *Gleosporium*.

2. The second type of leaf spot commences as a little brown spot (not unlike the early stage of the previously described spot) which rapidly enlarges, forming a large, dry, brown, lenticular patch. The centres of the spots often show concentric shading or zoning. At the edge is a narrow, dark brown margin, which is surrounded by a broad, diffuse, bright yellow halo, gradually merging into the dark green of the leaf. The spots may occur at any spot on the surface of the leaf, but frequently appear at the edge and tip.

So far, no organism has been isolated from this type of spot.

No treatment has been tried. Spraying with Bordeaux mixture or lime sulphur would probably have a beneficial effect if the absence of the more serious diseases made such a course worth while.

Eelworm.—These have been noted on the roots of unhealthy bananas, causing slight swellings. Their identity has not been determined, nor has their effect on the growing plant.

Marasmius Rot.—This disease, caused by a basidiomycete, *Marasmius semiustus*, has been reported, but has not been seen personally.

Other Fungi.—Various other organisms have been found in association with the banana, but appear to be merely saprophytes of no importance.

Fruit Diseases.

Sigatoka Disease.—This has already been dealt with. The symptoms are the yellow, hard flesh of apparently immature and green fruit. This disease is said to cause the fruit to ripen and decay very rapidly, and render its carrying properties very uncertain.

Anthracnose or *Ripe Rot.*—This is a well known banana disease caused by the fungus *Gleosporium musarum*. It has been seen on the plantation and on ripe fruit exposed for sale in Suva.

On the young fruit, the disease appears first as circular, black or dark reddish brown, shallow pits averaging about 1·5 mm. in diameter. These gradually enlarge, coalescing to form large black patches on the skin. Ultimately, the fruit becomes black all over and shrivels up and decays, or is attacked by the ferment fly (*Drosophila sp.*). Under moist conditions, little pink spots appear on the surface of the blackened parts; these are the spores of the fungus. The disease develops also in ripe fruit, causing a similar rot.

The fungus is a wound parasite, and attacks fruit which has been injured by scratching or bruising. Hence care in handling helps to reduce the prevalence of the trouble.

Black End.—This is a condition which is mentioned in the reports of the Fruit Inspector at Auckland. No description is given of it and its exact nature can only be surmised.

A condition which might be identical has been observed on bunches of fruit kept in the laboratory.

Commencing at the upper end of the bunch, the fingers become blackened and constricted at the stalk end. This rot continues until the fingers fall off the bunch with the slightest touch. A white fungus growth appears on the blackened part. Under the microscope, this is seen to be a species of *Fusarium*. It seems to be constantly associated with the trouble, and has been isolated in pure culture. Infection experiments were carried out on apparently healthy hands, but the controls showed the disease to some extent and the results were, therefore, inconclusive. The inoculated fruits appeared to be more severely affected than the uninoculated ones.

Exported Fruit.

Visits have been made to certain of the packing stations and to the "Tofua" during the packing and loading of bananas for the New Zealand market. A notable percentage of the fruit submitted for inspection was affected with Sigatoka disease, and a great deal of this and of immature or scabby fruit was rejected. It was noticeable that, even during the short time which elapsed between packing and loading, quite an appreciable quantity of fruit had ripened and the cases had to be repacked.

The reports of the Fruit Inspector at Auckland indicate that, at certain periods of the year (from about February to June), the fruit often arrives in bad condition.

Dealing only with those points which are of mycological interest the following conditions are reported: Black end; softening and watering of the pulp of apparently green fruit; mould; "steaming"; mouldy and dirty cases.

Black end has already been dealt with.

The turning to water of the pulp is a condition which cannot be explained on the meagre information at present available. It is interesting to note that a disease known as "squirter" is, at present, causing trouble in Queensland fruit. It occurs in fruit which has been in transit for some time, and is characterised by and gets its name from the fact that the pulp becomes fluid so that when the finger is squeezed it squirts out from the end like water.

Mouldy fruit might be due to ordinary saprophytic fungi which, under the warm and moist conditions of the ship's hold, would develop on the fruit, especially if the latter were bruised or injured in any way, or it might be due to a fungus which is present in the banana at the time of shipping.

"Steaming," and possibly, to some extent, the other troubles, might be due to excessive heat combined with deficient ventilation in the hold of the steamer.

The moulds, which occur on and give a dirty appearance to the cases, are principally the common saprophytes such as *Cladosporium herbarum*, *Aspergillus sp.*, &c., These are often found on damp timber, on damp walls, leather, cloth, &c. The remedy is to use cases made from dry wood, and to keep these from becoming wet with rain by storing them under shelter.

It is obvious that some serious troubles attend the transport of bananas and these require investigation. For that purpose, it would be desirable to visit Auckland with one of the shipments, and obtain first hand, detailed and accurate information as to the nature and extent of these troubles.

Speaking generally, the trouble in the exported fruit may be due to—

1. Diseases in the fruit on the plantation.
2. Careless picking, packing, and general handling.
3. Unsuitable conditions of storage during transport.

All three of these factors seem to be concerned, each accentuating the effect of the others.

The diseases which occur in the plantation have been dealt with already. The chief of these are Sigatoka disease and anthracnose. Infection with black end seems to take place before the fruit is shipped, as is evidenced by the fact that bananas kept in the laboratory developed the disease.

The packing and handling of the fruit calls for comment. The rough treatment to which it is submitted, the variable and, frequently, bad conditions under which it is transported is certainly not likely to assist the fruit in carrying to New Zealand, and less to Australia. Fruit of all kinds is extremely susceptible to bruising, and should be handled as carefully as eggs.

Briefly, the method now adopted is as follows: The fruit is cut on the plantation, carried in bunches in punts to the packing stations, there broken into fingers and packed into cases, the latter being stowed in other punts and brought to the ship's side. This applies particularly to the native fruit, the European planters packing on their own plantations.

The bunches from the upper parts of the Wainimala and Wainibuka are cut six days before shipping; down river, the time is shorter. During transport, beyond covering the bunches with banana leaves—usually diseased—no attempt is made to protect the fruit from the action of the weather, it being exposed to the intense sun or heavy rain. At the packing stations, which are simply patches of beach at specified spots along the river bank, the fingers are torn off the bunches and packed into cases. The method of packing is not satisfactory. In some cases the fruit is packed a layer above the top of the case, and the lid forced down in order to nail it on. The result is the squeezing and bruising of the fruit, especially in the upper layers. A certain amount of this is no doubt necessary for the tight packing of the fruit, but it appears to be over done, and the same result should be obtained by packing the fingers more carefully throughout the case. The cases are brought up just before packing commences, and remain all the time in the open, neither they nor the fruit being afforded any protection from the weather. During the journey from the stations to Suva a number of the punts have no covering, and their cargoes are exposed to the elements. In some cases the bottom layers of the cases become wet and dirty from bilge water in leaky punts, and in rainy weather, the same happens in uncovered punts from the rain water collected. Finally, without any previous drying, the cases are loaded into the hold of the steamer and closed up for several days until they are discharged at Auckland.

Under these conditions, it is not surprising that complaints are received from New Zealand respecting the quality of the fruit on its arrival.

The conditions under which the fruit is carried from Suva require investigation.

The temperature of the holds are taken daily by the ship's officers, and are recorded in the log book. During the first five voyages of this year, the maximum temperature in any of the holds was 86°F., the minimum was 63° F. The temperature at which the United Fruit Company transport their fruit, and which is considered to be the most suitable is 55° F.

The ventilation of the holds, according to reports, is not satisfactory. It has been noticed that, while the ship is loading, the ventilation fans do not appear to be working. Wind sails are used when the ship is at sea, and, according to the officers, this secures satisfactory draught.

The packing of the fruit in the holds seems satisfactory. The layers of cases are separated from those below by slats about one inch in thickness, and the cases are separated from each other in blocks, which allows the air free circulation between them.

The practice of stowing bananas on top of copra is one which is by no means favourable to the former. The heat generated by the fermentation of the copra tends to raise the temperature of the hold, and thus to accelerate the ripening of the fruit and the growth of fungi causing rot and decay.

The following general recommendations are made in connection with the export of fruit:—

1. The fruit should be handled more carefully so as to avoid, as far as possible, bruising and injury.
2. The fruit should be protected from the weather at all times. The punts should be provided with tarpaulins which can be erected to keep off the sun and the rain.
3. The packing of bunches and cases should be done in such a way as to allow the free circulation of air between them. The tarpaulin coverings should be arranged to permit free ventilation while, at the same time, affording protection. Wind chutes could be used with advantage on the larger punts.
4. The exportation of bananas in bunches, or even in hands, instead of in fingers would cause less injury to the fruit and, therefore, give it a better chance of carrying without deterioration.
5. Cases should be obtained from the mill in a dry condition and maintained so by storing them under shelter from the rain. Mould will not develop on dry cases.

Stricter supervision, more control and less injury from handling and exposure would be obtained by having large, properly constructed packing stations in central positions—an idea which, I understand, has been proposed already by the Inspector of Produce (Mr. E. S. Gordon).

Fruit brought from the plantations in bunches would be examined by the Inspectors, graded and packed under their supervision with much greater facility and efficiency than is at present possible, fumigated, loaded into punts and then transported to the ship's side and loaded without delay.

The greatest care is required in the packing and inspection of fruit intended for export to Australia. In the latter country, Fiji has a reputation for bananas which would easily be lost if anything but first class fruit were exported. It would be desirable to prohibit the exportation to Australia of fruit produced in areas in which Sigatoka disease is prevalent.

According to the daily press, the New Zealand buyers have requested that the exportation of fruit from the Wainimala be stopped. This would be unduly penalising the growers in that district. If action is contemplated in this direction it is suggested that, instead of total prohibition, the fruit coming from there (and from other badly infected places) be marked with a distinctive mark. This would indicate to the buyers the class of fruit which he might expect, and leave it optional for him to buy it, while, on the other hand, it would not prevent the grower from realising what he can from his plantation. As the areas become clean, either naturally, or by the efforts of the planter, the restriction can be removed.

General

The outlook, as far as banana diseases are concerned, *is serious*. There are many difficulties in the way of controlling the disease, as many of the planters are Fijians or Indians, and these cannot be depended on as can the European.

The first step in the matter is to eliminate those bananas which are of no commercial value, and are a source of danger to the commercial areas; and then to secure the registration of the latter and have them inspected periodically by a Government inspector who can advise and, if necessary, enforce precautionary measures in connection with disease. When this is attained, it will be possible to apply the general measures given in the earlier part of this report, and others which will be decided on as the investigational work proceeds.

The ideal method of dealing with the trouble would be to eradicate all the fruit growing in the infected areas and not replant there for a considerable period. This is impracticable under present conditions. New areas must be opened up sooner or later, and in these, the disease can be taken in hand from the time the ground is first ploughed. The first requirement is healthy plants. These are not at present obtainable here. There are few sources where an intending planter can obtain plants which he can be sure are free from insect pests or disease. This difficulty could be overcome by the establishment of a Government nursery in which clean plants could be raised and made available to those requiring them.

Future Work.

The following indicates the general lines on which the work will be conducted, as far as time and money will permit. It is hoped to do the field work in co-operation with the local planters.

1. Continuation of the laboratory work and general field work.
2. Trial of sprays and fungicides on and around the plants.
3. Treatment of the soil with lime and fertilisers, and drainage.
4. Experiments dealing with the storage and transport of fruit.

Acknowledgements.

In conclusion, I have pleasure in acknowledging the assistance which I have at all times received from the various officers of the Department and the assistance and hospitality of the planters whom I have visited.

THE BANANA SCAB MOTH.

To the casual observer, the disfigurement caused whilst bananas are green, by an introduced pyralid moth, is the most serious damage the fruit is exposed to before the bunch is cut for marketing. On neglected plantations the loss, through the action of the grubs of that scab moth, may amount to half the banana crop. The pest is spreading and in the opinion of Mr. J. M. Kyes, who recently visited Fiji on behalf of the United Fruit Company, this moth is one of the most serious pests encountered on Fiji banana plantations.

For want of more direct means of control, each individual bunch has to be dusted with pyrethrum powder and lime as soon as it grows out of the banana stem and careful planters repeat this dressing twice.

In the case of the Cavendish or dwarf banana, the kind grown in Fiji, this dressing is done without much trouble, but should this moth be intro-

duced and spread over the extensive plantations of Jamaica or Gros Michel bananas of the American tropics, step ladders would be required for reaching to the bunches and the resulting labour would, it may be well imagined, be enormous and costly.

When in Java some years ago the writer's notice was directed to the damage caused by this moth, but there it is not such as requires any particular method of repression, and the inference drawn was that there natural control keeps it in check. In Queensland where it is reported to be very destructive to green bananas some good work is said to be done by a hymenopterous internal parasite named *Tumidicoxa regina-dentata*, Girault, respecting which inquiries are being made.

In Fiji it occurs in a more serious form. Very little information is available about it except from the planters who know it at their cost. No parasite has been observed by the Entomologist attacking the pest, which the more careful planters control by dusting the banana bunch, when just opening, with a mixture of one part of pyrethrum and three parts either of sifted ashes or slaked lime.

Inquiries into the result of investigations by Entomologists in countries where the moth occurs in a wild form directed attention to Dr. S. Leefman's investigations on this Banana or Pisang Moth as it is called in Java.

The injury was traced there, as it is in Queensland, to the caterpillar of a Pyralid moth *Notarcha* (*Nacoleia*)*octasema*.

According the the *Review of Applied Entomology*, Vol. V, Dr. Leefmans ascertained that the period of incubation of the eggs which are deposited in heaps to be four days during dry weather at the close of the east monsoon, the maximum number of eggs laid by a single female being 80. The newly hatched caterpillars usually live between the fruits close to the stem of the bunch and become full grown in twelve days. Pupation appears to take place in the ground, among dry leaves, &c., in slender cocoons, the pupal stage lasting ten to twelve days. In the dry season (east monsoon) the time required by a generation is about thirty days, and in the wet season (west monsoon) about twenty-seven days. The wild food plants are unknown, nor have any traces of injury been noticed on wild bananas. In Java the only parasite is a braconid wasp.

Dusting as mentioned above is used as a successful means of control.

In untreated bunches 44–47 per cent. of the fruit was sound, this figure was 56–69 per cent. in bunches treated once and 80–87 per cent. in bunches treated twice.

Both tobacco dust and powdered unslaked lime proved ineffective. Though Paris green (one part to nineteen parts lime) was more efficacious than pyrethrum, it very often caused black spots to appear on the fruit. The cost of the pyrethrum for treating 100 bunches twice was about 1s., that of lime being negligible.

Advantage was taken of Mr. A. M. Lea's and Mr. T. C. McNamara's presence in Java in connection with a mission of investigation regarding the introduction of parasites of the *Brachartona cathoxantha* moth into Fiji to attack the allied *Levuana iridescens* moth to direct attention to the possible introduction of the Pisang moth's parasites as well.

Time did not permit this being done.

The Government Entomologist, Queensland, has also been communicated with, to ascertain whether arrangements could be made to procure parasitised pupæ of the moth from that source.

ROBUSTA BANANA.

At the November Session of the Legislative Council, the Hon. A. Barker, questioned the Government "regarding the advisability of importing plants of the Robusta variety of banana and which is said to be immune from attack of fungus disease."

Inquiries were in consequence made from the Director of Agriculture, Jamaica. It was explained that the "Panama disease" does not exist in Fiji. During the cool months, the plants show less resistance to Bunchy Top and to a leaf disease which also hastens the ripening of the fruit and is now under investigation.

The trouble is more in evidence on plantations that have outlived their prime and particularly when the black borers abound, also a root rot caused by insufficient drainage and in some cases by the presence of nematodes.

Unless therefore the Robusta Banana shows resistence to these troubles common to the banana its introduction is questionable, being attended with considerable risk of being the means of being able to act as a carrier of the *Fusarium cubense* fungus which is the causal agent of Panama disease.

It also remains to be found whether the American market will accept this Robusta banana when shipped in quantity.

The reply from the Department of Science and Agriculture in Jamaica has not yet been received, but it is doubtful whether plants could be procured from Panama disease free areas. In any case, it would be extremely unwise to incur the grave risk which the importation of these bananas would involve.

The banana in question was in the first instance introduced from Guatemala, and shows striking signs of resistence to Panama disease, and it is too early yet to say whether it is likely to replace the Gros Michel which has been wiped out of several of the affected areas.

SUNFLOWER (GIANT RUSSIAN).

By R. B. Howard.

The above-mentioned plant flourishes luxuriantly in Fiji, at least it does so in this district, Sigatoka, and is certainly of some consideration, as a commercial proposition, and likely to prove a lucrative one.

I find it grows well with little or no cultivation to speak of, although, of course, like every other plant life, the better the cultivation and the greater attention given it, the more bountiful the yield. Two varieties have been grown here, the "grey" and the "black," many of the heads being large and full of good, sound seed.

From inquiries it has been ascertained there is a good market for the seed both in Australia and in England, at a fair price. The seed would be worth from 12s. to 15s. per bushel f.o.b. Suva. As no machinery whatsoever is required to clean the seed, being much more cheaply and easily handled than maize, it goes without saying it would more than favourably compare with the latter as a profitable crop.

It is planted and cultivated exactly in the same manner as maize, and the seed is practically immune from attack by insects, such as weevil, &c. It would, therefore, appear the sunflower is well worth while considering as a business proposition.

Perhaps a short description of the plant may be acceptable: the sunflower (*Helianthus annuum*), is a composite (that is, the flower heads are

considered to be compound flowers). Its stem is cylindrical in form, full of a soft pith, and it reaches a height of from 9 to 12 feet. The leaves are alternate, broad and heart-shaped, from 12 to 15 inches in length. The flowers, with their golden petals are a magnificent sight, closely resembling a radiating sun; hence its name, not as erroneously thought by some because of its tendency to turn its face towards the sun.

In the variety now under notice the flowers, or heads, attain a diameter of from 18 to 20 inches or even more. These heads are so thickly set with seed that as many as 40,000 have been taken from one head; the seeds are somewhat wedged shape and vary in colour, some being quite black, others grey or white streaked with black.

In many countries, such as the United States of America and Russia, the plant occupies an important place in rural economy, and I am strongly of the opinion should do so in Fiji. It is admirably adapted to our soil and climate.

The sunflower is most sensitive to frost, or even less extreme temperature The best time to plant would be from September to February. The rows should be about 3 or 4 feet apart, and the seed 18 inches in the row. It would take some 4 or 5 lb to plant an acre. A fair estimate of the field of clean seed would be from 40 to 50 bushels to the acre. The growth is fast as a rule, the crop being ready to harvest in from 90 to 120 days.

The sunflower is a great evaporiser of moisture. It is said that when full grown it will evaporate 2 lb weight of water within twenty-four hours. As the evaporation means the production of cold, it would seem the sunflower, like the banana, is a desirable plant to grow near buildings which require to be kept cool.

It is of course mostly grown for the seed, which contain a large quantity of oil of a very high quality. The yield of oil being 50 per cent. of the weight of the seed, many people contend it is much more; the oil is much used for cooking purposes; it is of a straw-yellow colour, sweet and palatable.

In several countries large quantities of the seed are consumed in the same way as peanuts by both adults and children. They treat the seed in the same way as peanuts, by roasting, &c., and eat the savory kernels, which undoubtedly are a healthy and pleasant food. Many Europeans who have had the privilege of tasting them much prefer them to peanuts. In Russia they are called "Semotchkey." The seed is also a tip-top food for poultry, and induces egg-production. Pigs relish and thrive amazingly, and sheep are also very fond of them.

Again the large green leaves form an excellent food for all kinds of stock, particularly milking cows, besides being valuable for silage. The residue after the oil has been extracted is much in favour for feeding and manurial purposes; it is considered equal, if not better, than linseed or cotton-seed cake. The stalks make good firewood, the ashes from which are most valuable as a fertilizer, being very rich in potash; the pith contains much nitre, and will retain fire like tinder or a cigar.

There is a growing demand for sunflower seed; this fact should be sufficient inducement to the small farmer to devote an acre or so to its production, and as it does not impoverish the soil to anything like the extent of most other crops, its value as a money-maker should be appreciated.

No doubt the small farmer hesitates about growing an acre or more, without first being sure of finding a market for the product, but it must be borne in mind that poultry and all kinds of stock greedily eat both seeds and leaves, in this natural state, even the stalk can be cut up and most advantgeously mixed with other fodder. Moreover, it is claimed that both

seeds and leaves are a specific in cases of worms in stock; further, the sunflower is not subject to any disease.

Although the numerous uses of sunflower has by no means been exhausted, it is to be hoped enough has been said to induce every small farmer to try out an acre or two, thus adding to his general comfort, and in all probability opening up a new and profitable avenue of business.—*Fiji Times and Herald.*

MAURITIUS BEANS.

Mauritius Bean (*Stizolobium aterrimum*) or Bengal Bean is closely allied to the Florida Velvet Bean. Its chief use is as a green manure crop, being a soil renovator and a smotherer of weeds, though occasionally, if not usually, it is fed off by live-stock.

From notes supplied by Mr. James White, Inspector of Plantations, the best season for cropping in Fiji is at the beginning of the wet season in November and December. As a cover crop for green manure, the time of sowing may be extended to February. Two or three seeds are pressed together in the soil, at intervals of a yard, and it is not long before the vines which spread quickly, cover the ground with a thick blanket of broad leaves.

The quantity of seed per acre dibbled at intervals of 3 ft. by 4 ft. is about 15 lb per acre; if set at 3 ft. by 3 ft., 20 lb, and if broadcasted, 45 lb per acre.

Like some kinds of cow-peas, the Mauritius Bean strikes roots at joints where the creeping stems touch the soil. These roots covered with the nodules resulting from the presence of nitrogen producing bacteria, enrich the soil to a marked degree.

An increasing demand has arisen of late for seed, exported mainly to Queensland; these would probably also find a ready market in the Southern States of the United States for raising green crops in the rotation course. They grow there quite as well as in Fiji, but it is said that in this Colony, the Mauritius Bean pods more abundantly and, at all events, cheaper labour means lower cost of picking; this has to be done by hand as the pods ripen unevenly and is necessarily a slow process as compared with the methods used in farming practice of harvesting and hulling the pea crop by machinery.

In Fiji it has also been noticed that the Mauritius Bean seeds more prolifically in the dry than in the wet zone and also that the blossoms set better when the beans are sown with some other crop like maize or broad bean which will partly lift it from the ground.

When grown for seed, a heavy loam on the hillside is preferred, as on rich heavy alluvial flats and bilo land or flat river banks the vines run riot and bear fewer pods. On the light red and poorer soils originally under bracken and *Casuarina* (nokanoka), the growth is scanty, and the pods are smaller and pinched in the middle, carrying only two or three seeds per pod, whereas good pods on vigorous vines measure 4½ to 7 inches in length and contain four to seven beans.

The Mauritius bean producing a rampant crop is not sown with other crops which it would smother, but it is sown between maize when that crop has cobbed. The beans grow up the old stalks which eventually bend them down, keeping the vines off the ground. On the Caboni Estate, where large fields of beans used to be grown, this method was found to increase the yield.

It takes about seven and a half months from the date of sowing to the time of harvesting, *i.e.*, fifteen to eighteen weeks from sowing to blossoming, and eleven to fifteen weeks from blossoming to harvesting, the period of blossoming and of ripening of the pods being spread over several weeks.

For ploughing as green manure the crop is at its best about four months after sowing when the blossoming is at its height.

This is best done with a disc plough, the buried vines rotting within three or four weeks, when the ground is ready for cross ploughing and drilling.

On good land, ten to fifteen tons of green stuff per acre are not uncommon; this when buried provides a mass of organic matter which enriches the land with sufficient nitrogen to supply the requirements of several crops to follow.

At the same time the carbonic acid gas given off during the rotting process makes available stores of plant food locked up in the ground. Large quantities of phosphate and of potash extracted from the soil by the crop are then restored in a ready assimilable form, while the organic matter added to the ground increases the moisture holding capacity and enables air to penetrate and render more active the biological activities that take place in the ground.

In the West Indies, where these beans are likewise used as green manure, it has been observed that sickly lime trees around which Mauritius Bean had been growing regained their vigour after a crop had been grown.

The demand for the bean and the quantity exported for sowing as a soil restorative is steadily on the increase.

Harvesting is done by hand, no other method having been tried in Fiji, where labour is comparatively cheap or where the peasant Indian cultivator does not value his own labour according to the European standard.

After the pods are gathered they are spread out in the sun and when dry, a day or two after picking, they are threshed with a stick or a cudgel. If the pods are dry, they crack open after being thus exposed to the sun and the beans, which are scattered around, are swept together and bagged. Messrs. Burness Bros., at Caboni, tried shelling with a pea sheller without motive power, and found it just as expensive as shelling by hand, as it took four men to work the machine, with an average output of four sacks per day. It is quite likely however that with a suitable mechanical thresher and a small motor engine, this work may be expedited and done at a lesser cost. Under present methods, one labour unit costing 2s. 6d. to 3s. per day can shell one sack, with a flail, or a four bushel sack weighing about 260 lb. Nine and a half bags go to the ton weight.

It is reckoned that seven sacks of pods yield one sack of shelled beans and that the yield per acre ranges from two sacks on poor land up to five or six sacks on good soil, with an average of four sacks or nearly half a ton of beans per acre. A notable quantity of beans are besides left unpicked on the vines and are ploughed in, with the harvested crop. Stock eat the vines readily though it is not so used in Fiji.

The demand for the beans has, as already mentioned, been created by the overseas market, Northern Queensland absorbing increasing quantities.

The declared exports in 1923 were 961 cwt., valued at £1,402, and in 1924, 1,239 cwt., valued at £2,192 or 3½d. to 3¾d. per lb.

The price f.o.b. Ra coast is 2½d. to 3d. per lb, and the price f.o.b. Suva for overseas market is said to be 5d. to 6d. per lb.

The Mauritius Bean is remarkably free of diseases. It represents a crop for which an important export trade could be worked up and one that would benefit the land and the cultivator at the same time.

OIL PRODUCTION AND CASTOR BEAN.

THE following article is from *The Fiji Times and Herald* of Thursday, 15th January, 1925:—

While we discuss the value to Fiji of developing the oil industry by introducing the Oil Palm from West Africa or other oil-producing trees, we may be overlooking an oil producer which we have lying neglected within our Colony, the most valuable of all oils—the Castor Plant.

The castor oil plant, sometimes called "Palma Christi," on account of its beautiful palm-shaped leaves, is well known in most tropical and in many semi-tropical countries. While it is cultivated as a commercial undertaking in the West Indies and other parts, it is looked upon, in places, as a troublesome weed.

The oil is one of the oldest used, seeds of the castor plant having been found in tombs 4,000 years old. Because the seed had the appearance of the troublesome tick, the Romans called the castor "Ricinus," and the name has been retained by botanists.

The plant is a hardy one, and adapts itself to many climates. The crop is grown in the usual way by cultivation, and planting the seed in furrows or broadcast. The best way is to plant them six feet by six or eight feet by eight in good rich soil. Four seeds are placed in each hole. The main stem is nipped back to produce fruit bearing branches.

The castor oil plant has one remarkable virtue. It is practically exempt from pests, because, like humans, insects seem to shun it. It has even been suggested that it is a good pest resistant to plant castor plants between other crop plants which are liable to insect pests.

There are two varieties of seed—large and small. The former yield 25 to 30 per cent. of oil, and the latter 38 to 40 per cent. The plants commence to bear in the fourth month, so that quick returns will repay cultivation.

In India sometimes 15 lb of seed are taken from a single tree. In the United States, the average crop is calculated at from 15 to 25 bushels to the acre. The seed is sold in America in bushels of 46 lb each. There is always a ready market in Europe and America for castor oil seed. Commercially it is a sound investment. Prices are excellent. If we take 20 bushels as an average yield, we get 920 lb of seed per acre. The October price (the latest we have at hand) is £32 per ton, which would mean a return of from £14 to £15 per acre. Considering the easy manner in which the plant can be grown, this is an excellent return, one which should induce local planters to go in for castor cultivation as a very important side line.

Castor oil occupies the pride of place in the world's market. The October price was £73 per ton, against £54 for peanut, £44 for cotton seed, £44 10s. for linseed, £46 5s. for soya bean and £48 10s. for coconut.

Whatever way one regards castor seed production, the industry appeals as a very easy and profitable one. Our planters and landowners are looking round for a crop, which will be easily grown, will yield well, and—quite as important as any other phase of primary production—one which can always be assured of a ready cash market. All these conditions are met by the castor oil plant. It will be a profitable side crop for the small Indian farmer who can cultivate five or ten acres with his own and family labour. It will be a solid cash producer, and that is what Fiji requires at the present moment.

A plant for the extraction of castor oil is rather expensive, local growers could content themselves with growing and exporting the castor seed, and if the production grows and warrants the erection of a mill, the money will be quickly forthcoming.

The Agricultural Department will, we feel sure, be only too glad to supply full information, and may be able to arrange for the importation of the best and most marketable type of seed. The idea is no chimera, but a real solid opportunity to make good money.

The article reproduced above having directed inquiries from several sources regarding the prospect of developing the cultivation of the castor bean as a profitable industry, the following notes have been gathered from reliable sources:—

The castor oil plant as a crop is worthy of a systematic test, along with others in Fiji which have been neglected for want of facilities for conducting such tests.

It is well suited to tropical conditions and is easily propagated. Unfortunately reliable data are not available regarding the cost of collecting and of hulling the seed. The plant is hardy but does not thrive on wet, undrained land. It rather prefers a friable, dry soil, through which the penetrating roots find a good range. If it could be demonstrated that it is likely to thrive on the red, snuffy, laterite land of the rolling downs of the Bua coast, where grazing is scant and the trees consist mostly of *Casuarina* (nokonoko), large extents of land hitherto left uncultivated might be turned to profitable

account. Planted 7 to 8 feet apart, it takes 15 to 20 lb of seed of the small variety to plant an acre. When planted in strips, it is recommended for staying bush fires or for giving partial shelter against wind or sun to growing crops. It is also said to act as a deterrent against grasshoppers and insects attacking plantations, but this statement requires confirmation as some kinds of caterpillars are particularly fond of the leaves, such as the tussor silk worms (*Bomby arrindixlare* is the Indian name for the plant), and many others which are unmistakably pests.

As an oil producer the castor bean ranks among the lesser oleaginous plants. British India and Brazil supply over 90 per cent. of the castor oil production which amounts to 45,000 tons.

The average declared value of castor bean exported from India for the six years 1912–17 was £10 per ton; that of the castor oil of all grades for the same period was 2s. per gallon. Taking 232 gallons of castor oil to equal 1 ton, the average value of the oil was £23 per ton in India; while the average value of the oil exported from Great Britain was during the same period 3s. per gallon or £34 16s. per ton.

Since then prices have arisen, but there is no certainty that they will maintain their present high value.

Apart from India and Brazil, as already stated, the areas under castor beans are negligible. In Ceylon and many other countries the plant is regarded as a weed and its cultivation, although very easy, has been unremunerative.

Experiments in Ceylon show that 4 to 5 cwt. of seed per acre can be looked for, the seed being worth only a few rupees a hundredweight (5 cwt. of seed equal 12 bushels at 46 lb a bushel or 560 lb per acre).

In his *Commercial Products of India*, Sir George Watt mentions the crop as being generally reported as precarious, owing to its liability to being devoured by caterpillars.

It is an exhausting crop, especially on the soil resources of nitrogen and can therefore only be successfully grown in a rotation course, if the fertility of the land is to be maintained.

There are two or may be three kinds:—

(1) A tall bush of perennial growth, giving a large seed producing an inferior oil, which is extensively used in India for illuminating purposes and often called "Lamp Oil," also valued as a lubricant. The seeds ripen from seven to ten months from the time of planting.

(2) A smaller or annual variety, sometimes grown as a pure crop, giving a small seed, the better qualities of which by an expensive and more careful process of expression, afford the superior qualities of the oil of commerce and the finer grades the medicinal oil of pharmacy. It ripens seed in from four to five months.

(3) A third variety is said to yield a comestible oil with no poisonous principle.

According to Mukerji (*Handbook of Indian Agriculture*), the cultivation in Bengal is chiefly in the Patna district. All the cultivation needed is to keep weeds down; picking taking place from the seventh to the ninth month after sowing. The yield of clean seed is about 250 lb per acre when grown with other crops and 500 to 900 lb when grown by itself.

In Assam it is never grown for its seed, but always for the leaf which is used for the *eri* silkworm. Generally the crop is allowed to be self sown and is found in small patches growing wild in the gardens of those who rear silkworms.

In the United Provinces the crop is sown at the beginning of the rainy monsoon in March—April. Harvesting is not a labourious operation and it can be done by women and children going over the fields once a week at first, to pick the capsules when the calyces turn from green to brown. These mature very unevenly at first, the spikes can be cut later on and thrown in a heap on a clean floor in a shed and covered over with straw or with a cloth. After six days these capsules soften and the shells decay; after drying in the sun for two days there, the shells spilt open and the remainder is beaten with a cudgel to separate the seed. These fly around. A vigorous plant yields as much as 8–10 seers a year (a seer is a shade over 2 lb), but those grown in hedges, not more than 1 to 2 seers. If grown as a ratoon, the stem is cut back to 2 feet of the ground and they throw out numerous branches and give a larger crop though with an inferior quality of seed. The green leaves are eaten by cattle. The cost per acre of a pure cultivation of castor beans amounts to about twenty-four rupees (1 rupee equals 1s. 4d.).

On reckoning on a ten maund crop (the factory maund equals 74·67 lb and the Imperial maund at 82·28 lb), sold at the low average of Rs. 4 a maund, the balance cost of production shows a net profit of Rs. 16 or £1 1s. per acre. In the Bombay and Sind provinces, two forms are cultivated, the small annual and the larger perennial. Mixed castor and ground nut is a characteristic of the larger or *Kharif* crop. An experimental crop of this nature at the Surat Farm yielded 767 lb of castor bean per annum, worth Rs. 43 14 annas and a good ground nut crop with castor might on good ground yield in addition 2,000 lb nuts.

Madras was and is a large producer but the industry until lately was stagnant in that Presidency.

The industrial uses of castor oil are chiefly for house illumination, giving a clear and cool white light, although it is now to a large extent superseded by kerosene; it is also used as a lubricant of machinery and particularly for refrigerating machinery, aeroplanes, &c., as it does not congeal readily at low temperature; as a leather dressing; for the manufacture of transparent soap, also medicinally; the residual cake which contains about 6 to 7 per cent. of nitrogen, 1½ per cent. of potash, and 3 per cent. phosphoric acid represents a valuable fertiliser.

The clean seeds are husked before crushing for oil and the kernels inside, when crushed, yield at the mill half their weight in oil. Thus 100 lb of castor beans give: husks, 30 lb; oil, 35 lb; cake, 35 lb; total, 100 lb. On this basis, an average crop of castor beans computed to yield 800 to 1,200 lb of seed, or say 1,000 lb, would yield 350 lb of oil and 350 lb of cake.

Samples of seed 2 or 3 lb in weight of self-sown castor beans growing wild in Fiji, giving locality where grown, kind of soil and date of picking, will be thankfully received for analysis and for comparison with castor beans grown elsewhere.

LEVUANA IRIDESCENS.

By J. D. Tothill, D.Sc., Director, *Levuana* Campaign.

One of the needs of the moment is to tighten up the inspection of vessels going from infested to uninfested territory as, although the front door has been closed, the back door is open and it is well known that cutters occasionally go to clean areas from unclean ones without calling at one of the three ports of inspection.

Levuana is carried to new places almost entirely by human agency as its powers of flight are extremely limited. On a recent trip from Vitilevu Bay to Nadi a number of outbreaks were seen to be starting in native towns, the coconut trees being grey in the towns and green on each side. Further inquiries from all sorts of sources make it clear that the native town or a lunching place is nearly always the first point of infection.

The coconut leaf basket can under rather unusual conditions be a carrier of *Levuana*, but I believe that the "vulu" or matt-like fibre at the base of the leaf stalks is many times more dangerous.

In every *Levuana* infested tree the "vulu" becomes more or less coated with the white cocoons and what is of importance is that the chrysalids in these cocoons remain alive and need neither food or water for nine days.

A piece of this cloth taken from the tree at the right time with, say, twenty-five cocoons upon it and placed in a cutter could easily carry the insect to Bua, Taveuni, or to almost any clean island in the Colony. Thrown out on arrival at the native town the moths hatching from the pupæ would start an outbreak on the nearest coconut tree.

Many people have told me that this cloth is occasionally used for mixing and carrying native medicinal preparations, for wrapping round taro roots to prevent drying up, as packing material between bottles, and for wrapping round letters and other fragile articles.

There is danger of an outbreak on Taveuni and on Vanualevu as long as occasional cutters carrying baskets or "vulu" are arriving without inspection.

A plan is being worked out through the active co-operation of the planters and Native Department and the Government, providing a double inspection. All vessels not especially exempted will be required by law to call at any one of three places on Taveuni for instance before proceeding elsewhere on that island. At each of these three points a reliable planter will have full power to inspect and destroy any dangerous material; after obtaining a clean certificate from the planter at the most convenient of these three points the vessel can proceed to its destination on Taveuni.

Thanks to the enthusiasm of the planters the plan is also being worked out for Vanualevu and it is hoped will be gradually extended to all the important copra producing islands.

Certain vessels will be exempted from the plan, such as the regular passenger and freight boats that always call at Suva, Levuka, or Lautoka for inspection; private cutters of planters will also be placed on the exemption list as far as practicable.

As this plan puts full powers of inspection in the hands of the planters themselves I have high hopes that *Levuana* may be prevented from spreading further.

Without having to contend with outbreaks in new territory it will be possible to concentrate upon the programme the aim of which is to eventually reduce *Levuana* to a more or less innocuous pest.

This programme consists essentially of introducing all the insect parasites and wholly insectivorous birds that may be useful in destroying *Levuana* and that have no bad habits. This will take time, as the species needed occur some in Hawaii, some in Australia, some in Java and the Federated Malay States, and some in Ceylon; there is also a possibly useful beetle in France and the New England States of the United States. Also it consists of continuing the search for the original home of *Levuana* and to this end a qualified Entomologist is going to the only likely place not already searched, namely, Cochin China. Finally the possibility of spraying to deal with new outbreaks and to further prevent spreading will be gone into.

In connlusion the point may be emphasised that the only chance of dealing successfully with a new outbreak in a strategic locality lies in dealing with it in its initial stages before flight of moths occur. The Department is prepared to investigate all reports of suspected outbreaks immediately. Any small group of gray coconut trees in a native town should be regarded with suspicion. If there are white papery cocoons on the bases of the leaf stalks or on the "vulu" it is *Levuana*. Samples of "vulu" with the cocoons, and of the injured leaves should be sent in to the Department. It is much better for all concerned to have a number of false alarms than to miss a single genuine outbreak in its initial and vulnerable stage.

HOUSE FLY PEST AND ITS CONTROL IN FIJI.

By H. W. Simmonds, Acting Entomologist.

The disappearance of the house fly (*Musca domestica*) from most parts of Fiji, which took place about 1912, has been the subject of some speculation and investigation. Illingworth working at Nadi, noticed a brown ant carrying off the eggs and small larvæ, and attributed the scarcity of flies to their agency.

In January, 1922, whilst examining some pupæ which had been collected by the Medical Officer of Health, Dr. Carment, the presence of a *Spalangia* parasite was observed, and both this Officer and myself subsequently bred a number of these parasites. In consequence of this discovery it was suggested that possibly this parasite was the main agency which had brought about the great improvement.

Further observations have shown that this parasite is however very scarce, and for the past year I have been unable to recover it at all. Meanwhile, observations have been continued in the stables where the parasite was found, and these tend to confirm Illingworth's opinion that the ant (*Pheidole megacephala*) is the real controlling agency.

In these stables ants have been observed carrying off eggs and young larvæ, whilst two or three together were noticed removing larger larvæ. In open paddocks horse manure has been found to be full of this ant, and I have been unable to find a single larva present in such situations, with one exception at Nausori.

At the Public Works stables at Tamavua the manure is stacked in the open and was found to be swarming with ants, and not a fly larva could be found, whilst only one adult fly was seen. A similar state of affairs was noticed in outdoor manure heaps at Nausori and Lautoka, larvæ being only once found at Nausori.

The most marked decrease in the incidence of the pest seems to have taken place in the dry areas: Nadi, Lautoka, Labasa, &c., and it is here that the ant (*Pheidole megacephala*) is most dominant.

On the whole there seems little doubt that Illingworth's observation gives the true cause of the control of this pest in Fiji, and as such we should I think reconsider our treatment of stables and their manure, so as to give maximum conditions to the ant for its work.

I am of opinion that the closing of the bins in which the manure is kept has been a mistake, considering that it would be better to stack it in the open each day, thus allowing not only the ants to work, but giving free access to fowls, which scratch it over and pick up the larger larvæ which have escaped the ants when small.

I find that the horse-boxes are not completely cleaned out each day, nodules are left, and I found these to contain not only larvæ, but pupæ,

showing that they had been there at least five days. I am of opinion that where concrete floors are used they should be hosed down each day, to ensure complete removal of the manure.

It should also be remembered that the ants do not enter the nodules, and can only remove eggs and larvæ whilst they are still on the surface, and that once the maggot has entered the nodule itself its only enemies are probably fowls, and when present the *Spalangia* parasite, which bores into the drying nodules after the pupæ.

When stacked in the open several stacks might be made and the removal for garden use not allowed until it has been there for say three months. This ant is not wholly useful, as it is a household pest, and also is the chief one in Fiji which attends scales. I have also seen it removing mealy bugs from a fallen leaf, presumably to transport to a fresh one. Nevertheless its good work in reducing flies, and so disease, must outweigh the nuisance it is in these directions.

A CUT WORM PEST (*PRODENIA LITURA F.*).

By H. W. Simmonds, Acting Entomologist.

This moth lays its eggs in clusters, covered with a felt of fine yellowish-brown hairs, on bananas, roses, coconuts, cannas, and a vaiety of other plants, and on window curtains and other unexpected places. On hatching the young larvæ are at first green, and if the plant on which it lays its eggs is sufficiently succulent commence feeding all together on the underside. In dull weather they may continue to do so for some time, eating away the lower surface and leaving the transparent upper epidermis. When about three-eighths of an inch long, or sooner if exposed to warm sun, they lower themselves to the ground, and disperse, feeding upon young seedlings of a great variety of plants.

About this time the larvæ turn dark brown, and thence forward live as typical noctuid larva, remaining in a dark place such as the soil by day, and feeding at night. When full fed they make a cocoon in the ground, and the perfect moth emerges ten days or so later.

The moth has pinkish-brown fore wings, with a conspicuous light band transversely about midway. There is also a conspicuous slate coloured band near hind margin, and various other light pencilings and markings about the wings. The hind wings are pearly white with a dark line along margin.

Natural Control.

Although this insect has many natural enemies it is one of the most destructive of garden pests, and also does damage at times to bananas. The following natural enemies have been observed by the writer:—

1. Egg clusters in Tahiti were fifty per cent. parasitised by a black *Chalcid*. These were transported to Fiji, but subsequently found to be already present, although not so abundant here as there.

2. A larva found at Tamavua was noticed to have three bluish external maggot like parasites on the third and fourth (thoracic) segments. When full fed these maggots turned brownish, and passed underneath the caterpillar (which had died and shrivelled). This they fastened to the leaf with silk, and spun their own cocoons within its shelter. A minute *Chalcid* emerged seven days later.

3. A recently hatched mass of larvæ from a batch of eggs laid on a banana leaf were observed to be attacked by ants (*Pheidole megacephala*), which were rapidly removing the whole of them.

Recommendation.

The collection and destruction of the egg masses whenever observed is recommended, as despite its enemies this pest is exceedingly destructive to young plants.

(This moth was kindly identified by Mr. R. Veitch of the Colonial Sugar Refining Company.)

KUMALA OR SWEET POTATO WEEVIL (*CYLAS FORMICARIUS*).

Reporting on this pest Mr. H. W. Simmonds, the Acting Entomologist says:—In a recent shipment of kumalas to New Zealand over a hundred sacks were condemned owing to the presence of the larvæ of the Sweet Potato Weevil (*Cylas formicarius*). This beetle is widely distributed throughout the warmer portions of the world but, as a pest, can be largely controlled if care and precautions be taken. In parts of United States of America it has been quite exterminated over large areas where it formerly existed.

Description of Beetle.

The beetle is about one-third of an inch, with a reddish forepart and steel blue wing cases (elytra). It is strikingly ant-like in its appearance. The female lays her egg in an incision in the stem of the kumala, the resulting grub boring down the centre. The grub sometimes reaches the tuber but often in the first generation completes its cycle within the stem. Only thirty to forty days are required to complete its cycle and later generations attack other stems, also tubers not sufficiently covered with earth. Beetles emerging from kumalas in store also attack other kumalas in the store.

Method of Distribution.

The usual way in which beetles are carried from plot to plot is by using slips containing eggs or grubs from an already infected area.

Prevention.

1. Plant only on clean land on which no kumalas* have been grown for at least a year, also see that no kumalas are being grown on adjoining land.
2. Use slips from plants known to be free from the pest.
3. When harvesting the crop where the pest occurs, burn all old vines and leave no odd pieces of kumala in the ground.†

A method suggested to me by the Acting Superintendent of Agriculture of obtaining slips free from the pest when a clean source is not available is to select clean kumalas and stratify these in a nursery, taking the slips from these to plant up the land on which it is proposed to grow the crop. This matter is of the greatest importance to all growers of kumalas, but particularly to those wishing to export, as by taking precautions in these matters not only will they reduce their losses considerably but, unless Fiji can supply clean tubers to New Zealand, there is a possibility that that market may at some time be closed to us.

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* The weevil also attacks the roots of convolvulacæ such as Morning Glory and all such plants should therefore be destroyed on the land intended to be planted. Crop rotation is also evidently essential when the pest occurs. The life cycle of the pest is said to cover about a month.—Editor.

† Traps consisting of sweet potato tops half buried in infected ground and renewed once a week and burnt or fed to stock will destroy any eggs that may have been laid.—Editor.

BANANA BEETLE BORER (*COSMOPOLITES SORDIDUS*)

Also called the Banana Black Weevil Borer has now through carelessness in procuring sucker bulbs or corms from infected places, invaded many of the islands of the group.

It is not indigenous but was introduced with banana plants from overseas, having now become a cosmopolitan pest wherever bananas and plantain is cultivated.

Some islands are more widely infested than others, and as the beetle does not fly, it is possible with the application of protective measures for the control of diseases of plants to check or to stamp it out from carefully cultivated plantations. Islands free from this pest would find ample sale for all suckers they could produce and there is in that direction a field open for enterprising planters who could supply under a guarantee, clean banana suckers, at a price equally or slightly above current price.

The loss caused to plantations through this borer is obvious to all and yet it has been for years allowed to continue its depredations. Unrestricted dealings in plants from infested localities have been the cause of its being spread in an alarming manner.

Steps are at last about to be taken to check the spread of the pest and to gradually eradicate it from now infested ground. Concerted and continuity of action are all that is required in carrying out simple measures of attack. These will now be made possible by widening the operations of regulations under the Diseases of Plants Ordinance. It was only in 1918 that the Banana Borer was declared a pest under the Ordinance and Vitilevu was then defined an area where it existed. There was ample power therefore to deal with it on the main island, but there the matter rested, owing it seems to inability to enforce the controlling measures in a comprehensive manner.

The fact is now evident that the borer, if not altogether responsible for the deterioration of the banana crop in old plantations, is at least accessory to it.

The predaceous beetle introduced some years ago from Java, is only gradually establishing itself and it is early yet to feel its beneficial influence; while it is getting established, the pest becomes more numerous and wider spread.

Under the circumstances it has been deemed desirable to extend the area which will be brought under the operation of the Regulations and this was done by Notice in the *Royal Gazette* of the 16th January, 1925.

By virtue of this Notice that area is now extended to the islands of Vanualevu, Koro, Ovalau, Nariau, Gau, Kadavu, and Beqa.

INSECTIVOROUS BATS.

In June last the Agricultural Department consulted Dr. Charles A. R. Campbell, the President of the San Antonio Academy of Medicine, Texas, regarding small insectivorous bats to the study of which he has devoted many years.

The Doctor's opinion was then sought with the view of utilising these bats in the campaign against the *Levuana* moth pest of the coconut plantations.

These small beneficent bats, as their dentition indicates, are purely insectivorous and quite distinct in that respect from the large Flying Fox

(*Notopteris macdonaldii*), which has gained notoriety as a fruit eater and is therefore itself a pest.

Dr. Campbell has for many years given attention to the treatment of Malaria and to that effect he has achieved striking success by enlisting the co-operation of a small insectivorous bat. He has built roosts found congenial to these small animals which are attracted to these structures by means of appropriate spray solutions.

That mosquitoes cause Malaria has long been known. That small bats prey upon mosquitoes almost exclusively is the discovery of Dr. Campbell. By his bat roosts he has reclaimed a large area of land around San Antonio and made the locality habitable by man and cattle. From these roosts stocked with thousands of bats, notable quantities of bat guano are collected and sold.

Dr. Campbell has recently written a book entitled "Bats, Mosquitoes, and Dollars," in which he tells some of the interesting facts he has learned about the habits of these flying mammals. He states:—

Bats are found all the world over. There are more than two thousand different varieties, classed as the oldest of mammals, and geologically considered going back millions of years. The female usually brings forth one or two young annually.

Its normal habitats are caves and sometimes abandoned mines and quarries. The normal position of bats in repose is hanging head downwards by their short hind feet which resemble tiny hands and are provided with very sharp and curved rigid claws so that when they hang no muscles are brought into action, this insures perfect hanging with all free body movements, such as scratching themselves, love making, &c.

It is the only animal that hunts its food through the sence of hearing, while its own flight is noiseless. Peculiar hair covers the entire body and convert it into a vital radio, the hairs serving as an antennæ for capturing the different sound waves emitted by mosquitoes and other small insects in flight. It also protects the animal against its natural and principal food, the malarial mosquito.

Bats are conserved by going into a state of suspended animation or hibernation in the place where they roost for the winter. They can be heard screeching and moving about on warm days, but after a cold snap they can be handled like so many dead sparrows, tossed and thrown about apparently lifeless. Thus therefore a ready means offers for their transference to long distances. No winged creature has such an amazing muscular strength to furnish its wing power, it is thus enabled to keep its flight the whole night long.

The longevity of the small animal is remarkable and it is presumed that it lives for twenty-five or thirty years.

The writer has visited several caves in the vicinity of Suva where small insectivorous bats are found, while others are also known in Samoa.

Dr. Campbell requests small bunches of hair from the bats in these islands and would feel very grateful for a few specimens which would be transmitted to him for identification if sent to this Department, preserved in methylated spirits or in a solution of formaline.

VETERINARY NOTES.

By C. R. Turbet, B.V.Sc., Government Veterinary Officer.

MANGES OF DOGS IN FIJI.

Auricular Mange of the Dog.

Synonyms.—Auricular scabies, Parasitic otitis, bad ears, sore ears, ear trouble.

The attention of dog owners is drawn to this disease of dogs which is so common in Fiji. Not that there is need to draw attention to the prevalence of the disease, and its ravages, but rather to the nature and means of combating the complaint.

Incidence.—From my own observations, the disease is widespread in Fiji, attacking all breeds of dogs and owing to its contagiousness, many dogs in the same locality are often affected. Unfortunately, owing to the ignorance on the part of the owner as to the nature of the disease and means of combating it, and at times owing to apathy, the disease goes on unchecked bringing on a condition which is very distressing to the animal and to witness.

The cause is a small mite known as *Chorioptes auricularum* and the same mite is often burdened with another name *Otodectes cynotis*. To the naked eye the mites may be seen as very minute grey specks almost indiscernable among the debris and secretions of the affected ear. Under the microscope they appear as roughly oval-shaped bodies, flattened, with head and mouth part at one end. At the head end are two pairs of fairly well developed legs and at the posterior end two pairs of rudimentary legs which in the female are produced in the form of two hairs on each side. The body is sparsely covered with spines or bristles.

In the earlier stages of the disease symptoms may not be apparent, later the owner becomes aware of the presence of disease by the animal becoming restless, with frequent scratchings and flappings of the ears. This is often accompanied by whining and howling, at times the animal will scrape the side of the head along the ground in its endeavour to gain relief. On handling the animal interference with the ears is resented, but with gentleness and patience this resistence is overcome, and examination within the ear reveals an abundance of a chocolate-coloured slightly granular cerumen in the extrernal auditory canal. This is often foetid. The fine hairs within the ear are matted with the secretions which often also soil the hairs outside and beneath the cavity of the ear as it drains away. The lining membrane is inflamed and the canal is often the seat of suppuration and abscess formation due to infection with pus forming organisms following the irritation and subsequent injury in the endeavour to gain relief. The odour from the affected ears is often very offensive.

Not infrequently injury results to the tips of the ears through continuous flapping and scratching, they bleed and at times ulcers are formed, covered with blackish scabs, splitting of the ears at the tips often follows.

Epileptiform fits are rarely seen in connection with the disease. The condition readily yields to treatment, when this is performed thoroughly. A fine curved pair of forceps facilitates the cleaning, or a soft, smooth, thin stick, the end of which is wrapped in a piece of cotton wool is useful. A glass syringe is also useful and in fact necessary for successful treatment.

Treatment.

Cleanse the cavity of the ear with pieces of cotton wool on the end of the forceps or stick, dipped into linimentum saponis, alcohol, ether or soap suds, introduced with a spiral motion. When thoroughly cleansed wipe the inside dry with a piece of dry cotton wool. The ear should then be irrigated daily with a solution of one part hydrogen peroxide and two parts water; or boracic acid, one teaspoonful in a pint of warm water. Other good injections are: napthol one part, ether three parts, olive oil ten parts, inject once daily; or, ointment of mercury nitrate one drachm, olive oil one ounce. Mix these well and paint the whole of the inside of the ear with a camel hair brush, or pour in a few drops, a week after syringe the ear with tepid water and methylated spirit one in ten.

This information is published for the benefit of country residents where it is impossible to obtain veterinary assistance but where medicines can usually be obtained.

Owners should frequently inspect the ears of their dogs in order that the disease may be detected in its early stages.

OVERGROWN HOOFS.

Overgrown hoofs of cattle leading to a condition simulating Foot Rot is common in localities where the animals are continually running on soft wet ground. In these cases the wear of the hoof is not proportional to the natural growth. The toes of the hoofs become elongated and often tend to cross each other in a scissor-like manner, resulting in wounds of the sensitive structures of the foot, generally in the interdigital space. Pus-forming germs gain entrance and the wound suppurates. This condition is very painful and is accompanied by inflammation and lameness. The animal is disinclined to move about in search of food. Condition falls off, milk secretion is inhibited and altogether the animal presents a sorry spectacle.

I have seen a few cases in Fiji of deformed hoofs resulting from laminitis (inflammation of the sensitive horn secreting structures of the foot), these are not so common and do not lend readily to treatment. I do not propose to deal with those cases here, but rather to the first mentioned condition.

Treatment.

In the first place, prevention is better than cure. Whenever possible the cows should be given access to hard stony or gravelly land. This tends to harden up the horn and does help greatly to keep the wear proportional to the growth. Owners should never cease their vigilance in regard to the health of their stock in general and as it is easy to detect this particular condition in its early stages, treatment should be adopted at once and the condition prevented from developing to a dangerous degree. All overgrown horn should be pared with a hoof-knife, rasp, or special hoof cutters, which can be procured, if not locally, in New Zealand or Australia. Sufficient horn should be removed, but some care is required to ensure that the cutting away is not proceeded too far with, and sensitive structures injured. At times granulating tumour or wart-like growths are found in the interdigital space. These can be removed by one of the following methods: simple excission with a sharp knife; or touching the growth with strong sulphuric acid or silver nitrate stick.

In suppurating, cases which are accompanied by an offensive odour, and necrotic areas it is necessary to wash the hoof thoroughly with an antiseptic solution of which the following are useful: lysol five per cent., kresol five per cent., carbolic acid five per cent., phenol five per cent., copper sulphate (blue stone) six ounces to one gallon of water and almost any other good antiseptic in sufficient strength will answer the purpose. These can be applied by standing the foot in a bucket containing the disinfectant solution (a wooden bucket is preferred for this purpose) or a cement foot bath can be prepared at the cow-house through which the affected cows can be passed. A good dressing for the ulcerating necrotic patches between the claws consists of finely pulverised blue stone one part, lard or vaseline, or a mixture of the two in sufficient quantity to make a firm ointment with the blue stone. This can be applied between the claws or wherever necessary and a bandage applied.

When the pastures are in a muddy state it is well to keep the animal in the cow-house and hand feed until the condition is cured.

Walking the herd through freshly slaked lime spread at a convenient gate has a beneficial action on the condition.

DEMODECTIC MANGE.

Synonym—Red Mange—Follicular Mange.

This troublesome and often fatal disease of dogs has been identified as occurring in Fiji, and strange to say, most of the cases I have knowledge of here have occurred among bull dogs or cross-bred bull dogs. That does not mean that other dogs are immune, for it is generally recognised that all breeds are susceptible, but there is a predisposition for young short haired dogs to contract the disease.

It is caused by a lanciform shaped mite, which enters the oriface of the hair follicle and there multiplies rapidly. Both the hair follicle and the sebaceous glands then contain large numbers. The whole of the body becomes affected and literally the mites become present in millions. Owing to the accumulation within the follicle the latter is dilated, irritation is set up, the hair bulb is destroyed and the hair falls out.

Symptoms.

Its course at the commencement is slow, but owing to its great resistence to treatment, general septic intoxication often results, terminating in death. In the early stages there are just a few reddened areas in certain parts of the body, notably, about the eyes, breast, elbows, hocks, and toes. As the hair falls out small papules appear and the affected patches are covered with fine powder-like scales. The disease is spread by mites abandoning the originally affected areas and spreading to the surrounding healthy skin. This is aided by the rubbing and licking of the animal. As new parts are invaded the skin becomes decidedly red, especially about the cheeks, breast, and legs, but may be anywhere; it is thickened, wrinkled, and crusty, eyelids are swollen and often covered with a purulent discharge. Generalisation of the disease results, the inflammation of the skin increases and the body gives off a disgusting odour. The appetite is often lost with resultant emaciation.

The disease is contagious and as such it should be isolated from other animals.

Treatment.

Treatment cannot be said to be very easy. It requires patience, a continued course of treatment and care to effect a cure. The method I have found most successful is as follows:—

First Day.—Thoroughly wash with soap and warm water, dry and then immerse in a bath made by dissolving one ounce of potassium sulphurata in a two-gallon bucket of warm water, allow to dry. When dry, paint a portion (not very large) of the body with compound tincture of benzoin (Friar's Balsam).

Second Day.—Paint another small area with the same medicament. Continue this daily until the whole body has been covered once.

Repeat the whole process or substitute tincture of iodine for Friar's Balsam on very small areas. A third course of treatment may consist of daily applications of sulphur ointment, viz.: sublimed sulphur one ounce, lanoline or lard nine ounces. Internally, five to ten drops of Fowler's solution may be given twice daily. A diet of fresh milk, fresh raw meat and cooked bones is advised. Bowels should be regulated with aperitives and if necessary enemas.

WORM INFESTATION OF PIGS IN FIJI.

By Chas. R. Turbet, B.V.Sc., Government Veterinary Officer.

The following correspondence and report are the result of an investigation into a mortality of pigs at Samabula, characterised by continued and progressive emaciation and, finally, death. The cause of the trouble was diagnosed as severe worm infestation. Post mortem examination resulted in the parasites enumerated being found in great numbers. Specimens were collected and forwarded to the Chief Veterinary Surgeon, New South Wales, who kindly forwarded them to Mr. I. Clunies Ross, B.V.Sc., Walter and Eliza Hall Veterinary Research Fellow, who kindly examined the parasites and reported on them:—

The specimens forwarded for examination are:—

(1)—*a.* Pieces of the wall of the stomach of a pig with worm parasites attached.

b. Small bottle containing detached worms labelled 1B. I conclude that these are *Gnathostomum hispidium.*

(2)—*a.* A bottle containing minute worms from the mucous membrane of a pig's stomach. Possibly these are *Ostertagia rubida* (strongylus rubidus). In the live state they were reddish in colour and present in thousands but could only be seen on very close examination.

b. Two slides with same worm mounted.

(3) A bottle containing small white nematodes from the small intestine of a pig. (Ilium). Present in thousands.

(4) A bottle containing nematodes from the Cæcum of a pig.

(5) A bottle containing nematodes from large intestine of a pig. Probably the same as (4). Present in thousands.

(6)—*a.* A bottle containing worms from the perirenal tissue. I am of opinion that these are not *Stephanurus dentatus*, but *Sclerostomum renium* (Drabble).

b. A jar containing kidney from a pig showing infestation by the same worm particularly in diverticular of the ureters. (2) A piece of liver and diaphragm showing the same worm lying in the tissue between the diaphragm and liver. Also abcesses in liver. (3) A piece of the heart showing a worm coiled in the mediastinal fold of the pleura. (4) A piece of dorsal aorta from near the heart showing a nodule suspected of containing the same worms. (5) A piece of lung. On opening along a bronchus a worm of the same species was found lying along the outside of the wall of the bronchus in the lung tissue. A lung worm, *Metastrongylus apri*, was also taken from the piece of lung. Note the hardening of the bronchial walls.

This is interesting from the fact that all these different species of worms came from the one sow, which was very emaciated.

I am of opinion that parasitic infestation is the worst ailment of pigs in Fiji although it has been said and is believed by most people that Tuberculosis is the chief cause of their unthriftiness. I am out to disprove this belief.

To this communication the following was received:

REPORT OF NEMATODE PARASITES OF THE PIG IN FIJI.

By I. CLUNIES ROSS, B.V.Sc.

Specimens sent by CHAS. R. TURBET, B.V.Sc.

Specimen 1*a and* 1*b.*—These parasites were *Gnathostomum hispidium* (Fedtschenks 1897).

Life history.—This is so far unknown. They are not generally considered to be of great pathological importance, but evidence on that point would be of interest.

Treatment.—Carbon tetrachloride in dose rate of 0·6cc per kilo given in 1 to 4 ounces of castor oil, after a fast of from 24 to 36 hours is said to have been effective. It would be advisable to test this thoroughly before advising treatment. Oil of chenopodium would probably remove those worms with which it came in contact.

Specimen 2.—These are *Ostertagia rubida* (Travassass 1918), syn. *Strongylus rubidas* (Hassal and Stiles 1892).

Life history.—Not known.

Treatment.—Oil of chenopodium or carbon tetrachloride could be tried.

Lesions.—When numerous they are said to cause a catarrhal condition of the mucosa.

Specimen 3.—These are *Crassisoma urosubulatum* (Alessandini 1909), one of the two adult *Strongylids* occurring in the pig. Though little reference has been made to their occurrence in the pig or the lesions and symptoms which they produce, it is probable that they would produce lesions similar to those produced by the hookworms (Ancylostomes) in man and the dog.

Life history.—This has not been ascertained, but from analogy with other members of the sub-family, it would most probably be by the ingestion of, or by penetration of the skin by the third stage ensheathed larvæ.

Treatment.—Oil chenopodium or carbon tetrachloride would probably be efficacious. Oil of chenopodium can be given to pigs in ½ or 1 drachm doses for a 100 lb pig. It should be given in or immediately followed by 2 ounces of castor oil.

Prophylaxis.—Isolation and treatment of infected pigs and safe destruction of fæcis. Larvæ would probably not reach the infective stage for four days at least.

Specimens 4 and 5.—These worms belong to the genus *Oesophagostomum* of which the only recorded species in the pig is *Oesophagostomum dentatum* (Meolin 1861). They are the cause of nodular disease of the intestine, as are *O. columbianum* in sheep, and *O. radiatum* in cattle. Mr. Turbet does not state, however, whether he has noticed nodules associated with their presence. [There were no nodules present.—C.R.T.]

Life history.—Development is direct. Larvæ when ingested bore into the sub-mucosa of the large intestine causing nodules. After undergoing a certain amount of development they leave the nodules and reach the lumen of the intestine where they reach maturity.

Prophylaxis.—Where pigs are kept in sties and fed from troughs they are less likely to become infected.

Specimens 6a and b.—The worms in this bottle are *Stephanurus dentatus* (Diesing 1809). Drabble's description of a new species, *Sclerostomum renium*, was due to his having taken an early description of *Stephanurus* as correct. *Stephanurus dentatus* has two equal spicules in the male, and the vulva is situated posteriorly in the female, which are the two characters by which Drabble based his description of *Sclerostomum renium*.

Stephanurus dentatus belongs to the sub-family *Stephanuræ*, family *Strongylidæ*.

Life history.—Ascertained by Benoid and Bauche 1814; infection takes place by ingestion of ensheathed larvæ, or by their penetration through the skin. Those which penetrate the skin ultimately reach maturity and their eggs escape into the uretors and reach the exterior. Larvæ which are ingested do not reach the kidneys but are carried to the liver and occasionally reach the lungs. Such larvæ may reach the adult stage but males and females have never been found together, individuals always occurring singly. Since copulation does not take place and as there is no way in which eggs could reach the exterior, the life cycle of the parasite in the liver or lungs ceases. It is only through those parasites which reach the perirenal and periuretal tissues, that is those which have penetrated the skin, that carry on the life cycle.

Lesions and Symptoms.—The lesions caused by the parasites in the perirenal and periuretal regions are not considered to be of great importance as there is little if any involvement of the renal parenchyma. Often, however, associated with their presence there may be considerable quantities of pus in the hilus of the kidneys and the uretors, so that the parasites might be at least a predisposing cause of disease. In contrast, however, to the benign nature of the lesions in these situations, where parasites are found in the liver, there is frequently said to be considerable cirrhosis of the liver, while the pigs may show a profound and somtimes fatal cachexia.

Diagnosis.—Centrifugation of urine and examination of sediment will show eggs in an advanced state of segmentation.

Treatment.—Medicinal treatment is useless from the position of the parasite.

Prophylaxis.—Where pigs are kept in sties and fed from troughs, prophylaxis is more practicable than where pigs are running in paddocks foraging for food.

In sties pigs should be kept on concrete floors, from which urine will run off. Where possible urine should be collected to prevent development of larvæ with subsequent reinfestation of pigs. Battens placed so as to keep pigs off the sty floors and which can be well cleaned are a safe guard. Since larvæ take five days to reach the infective stage, thorough cleaning of sties and removal of surface soil would keep down infections. Pigs kept in sties are more likely to show kidney lesions, infection through the skin being favoured. Prophylactic measures where pigs are running in paddocks and where pastures are constantly being reinfected are not likely to be successful, under these circumstances infection, with the presence of lesions in the liver, may be as frequently met with as skin infection.

6b. Several worms were found encapsuled at the attachment of the liver to the pillars of the diaphragm. There were several cirrhotic areas in the liver probably due to *Stephanurus dentatus*, but no worms were found in these. The worm found in the mediastenum was also an immature specimen. None were found in the lung tissue. The nodule in the aorta was not parasitic but consisted of lymphoid tissue.

THE BURDIZZO CASTRATOR.

The attention of stock owners is drawn to a new and improved method for the castration of bulls, rams, boars, and male goats. The operation is performed by means of a large and powerful pair of pincers with triple action joints.

Without doubt this new instrument provides the quickest, easiest, cleanest, and safest method for the castration of animals of all ages. The operation can be performed standing or with the animal cast on its side. When done

standing the animal should be held by the head and secured alongside a fence, in a crush or in a stall. The operator stands behind the animal, and seizing one testicle, pulls it down into the scrotum. Holding the castrator open with one hand, with the thumb and index finger of the other hand he pushes and holds the spermatic cord against the external side of the scrotum and, pressing the jaws of the castrator on the cord a little above the testicle, he closes the instrument with the aid of his knee until the jaws hold the cord so that it cannot escape their grasp.

The operator now takes the handles in both hands and presses strongly until the jaws are completely closed.

Opening the castrator he makes a second compression on the cord a little higher than the first, so that the cord may be crushed in two places. The same operation is then performed on the cord of the opposite side and the operation is completed.

By this method no blood is shed, and no external wound is made, hence the risk of infection is obviated. Any person at all used to handling stock can perform the operation, and it should be of especial use to those people whose religious principles prevent them from shedding blood and is, in fact, a humane modification of the old brutal method of pounding the testicle between stones as performed by some East Indians.

I have no hesitation in recommending the use of this instrument and will be glad to demonstrate its use to country residents while on my tours of inspection in the country districts. At other times the instrument can be seen at the Agricultural Department.

At present this instrument is only procurable in England, at a cost of £3 17s. 6d. A good idea would be for several farmers to purchase one jointly. The Agricultural Department would be prepared to arrange for purchase of the castrators for farmers wishing to invest in one. The London Agent and distributing house is that of Arnold and Sons, Veterinary Instrument Manufacturers, 50–52 Wigmore Street, London, W1.

FIJI SORES.

This complaint of horses is caused by a fungus, *Sporotrichon beurmanni*. It was first isolated in Fiji by Dr. Carment, one time Government Bacteriologist. It is contagious in so far as that should the fungus gain access to an accidental wound a Fiji sore will result. The wound is prone to occur on horses in the region of the fetlock or knee, hence the site of Fiji sore is usually on the fetlock or about the legs. A case of Fiji sore is a potential spreader of the disease but there is reason to believe that the fungus can carry on an outside existence probably in the manure about a stable or in a moist field containing plenty of organic matter.*

Treatment.

Externally.—Clip all the hair away from the edge of the tumour. Paint with strong iodine or with strong Gram's iodine solution. A dusting powder, Bismuth Formic Iodide, may be used with good results. To keep flies away, smear around the wound a liniment made as follows: Creosote, 2 drachms; oil of turpentine, 2 ounces; coconut oil, 4 ounces.

Should the tumour be in a position favourable for surgical extirpation under anæsthetic this may give better results.

* Horses running on spiny sensitive plant might get scratched about the fetlocks and access would thus be possible.—Editor.

Internally.—Give potassium iodide, 2 drachms, twice daily as a drench or dissolved in the drinking water or mixed in the food. Continue for eight days, then substitute the following mixture: Red iodide of mercury, 2 drachms; potassium iodide, 2 drachms; water, 24 ounces. Give one ounce of this mixture three times a day in water or food as a drench. This latter treatment may be alternated with the former until a cure is affected.

Subcutaneous injection, one drachm of Lugol's solution of iodine injected obliquely under the tumour from the edge will produce good results.

CATTLE DIP.

To all intents and purposes, Fiji to-day is a tick-free country, as far as cattle are concerned. The only species known to exist being the *Amblyomma cyprieum* chiefly affecting pigs but occasionally found on horses and cattle; another, *Rhipicephalus sanguineus*, occurs on dogs only, and is troublesome in some localities where it is found. It was introduced by dogs coming from Ceylon about 1904.

The first one has never been very active and no fear is entertained that it will become a pest.

The ever present danger, however, of the more serious tick introduced into New Zealand (*Hœmaphysalis bispinosa*) and the much more troublesome tick infesting cattle in the tropical and the semitropical portions of Australia (*Margaropus australis*) are a menace that is real. Against the possible introduction of these pests timely measures must be taken.

Every reasonable precaution that clean certificates issued by authorised veterinary surgeons can give, the length of the sea journey itself, examination on arrival, followed by spraying with the recognised arsenical mixture and strict quarantining, have so far proved efficacious in keeping these pests out. To these, additional precautionary measures are going to be extended.

The Government has decided that live-stock should be dipped on landing at Suva. Plans and specifications have been prepared, the dip is now ready for use, and regulations are drafted which govern the importation of animals, including dipping and quarantine.

CATTLE IMPORTATION.

During the last twelve months the importations into Fiji of pure bred and grade dairy stock has been greater than for a long time past.

This is accounted for by the operations, under modern factory methods, of the Soldiers and Sailors Dairy Scheme at Tailevu, of the Rewa Co-operative Butter Factory, and of the Fiji Pastoral Company at Navua.

In addition to those importations mentioned in the last issue of the *Agricultural Circular*, the following cattle were imported in 1924:—

One Shorthorn bull from Australia for the Colonial Sugar Refining Company; thirty-four pure bred and grade Freisian cattle from New Zealand for Mr. Ducker who is located at Navua; ten Freisian heifers from New Zealand for Mr. A. H. Witherow, on the Rewa.

Cattle Exports.

Fifteen head of Zebu cattle were exported to the Solomons during 1924 for the purpose, it is believed, of breeding working animals for work on Lever Bros. Limited Plantations.

RATS AND COCONUTS.

Increasing concern has been shown lately by coconut planters respecting the depredations of the rat pest. The Vanualevu Progress Association in particular has backed up the representations made by individual planters regarding the depredations by rats in coconut crops. The pest seems to be spreading, causing loss which must run into many thousands of pounds annually. In some localities kumalas, maize, rice and other food crops that planters depend on a good deal for labour rations suffer severely.

The position is one requiring attention and concerted action between planters, native growers and the Government. In order to formulate suggestions for combating the pest, advantage was taken of a visit to the Savusavu Bay district by the Government Veterinary Officer who met the members of the Vanualevu Association at a specially-called meeting, after visiting several of the affected localities.

Mr. C. R. Turbet's report is here given and was duly submitted to the Department of Native Affairs who readily agreed to co-operate in the effort contemplated to reduce the rat pest.

Report by C. R. Turbet, B.V.Sc.

According to arrangement I attended a special meeting of the Vanualevu Progress Association at Qaka, Savusavu, on the 28th January to collect information concerning the depredations caused by rats against coconuts, other growing crops, stored foods and drapery, &c., in stores and houses. This was done with view to inauguration of a means of controlling the pest so as to reduce losses to a minimum.

After delivering a short address to the members I put questions to them covering a wide field concerning their own experience. From this discussion and my own observations I gained that the rat attacks growing coconuts, pineapples, kumalas, cassava, maize, cocoa, rice, beans, all stored foods, copra in sheds and drapery in stores.

The rats are both terrestial, taking advantage of any cover, piles of stones, holes in the ground, undergrowth, debris, &c., and arboreal, living in the crowns of the coconut trees, seldom coming to the ground. They prefer the shorter trees, are commonly found in trees 25 to 30 feet in height, and occasionally seen in trees up to 60 feet.

Practically all plantations are affected, but none are completely over-run. They tend to remain in colonies in certain groves, more commonly the groves near the sea-shore were the infested ones, but in some cases groves far from the sea were infested. They are also spreading to the younger nuts away from the sea-shore which are now coming on.

It is not usual for the rats to inhabit the bush, preferring rather to live where man, by planting, provides greater abundance and more appetising food. The rat however at times, when conditions as to food supply are suitable, does take to the bush.

According to consensus of opinion it appears that it is only in the last ten years that the damage done by the rat has assumed alarming proportion. During this time no organised attempts have been made to reduce their numbers. In isolated cases however planters have tried poisoning, virus, traps and the use of tin collars on the trees. These efforts were not sufficiently extensive and continuous to have any appreciable effect. It is not to be denied, however, that the use of tin or galvanised iron collars gives absolute immunity to loss, so long as the collars are properly applied and are not rusty.

The estimated loss as given by the planters is 10 per cent. I do not believe that it is actually so great, from my observations, although in badly-infested groves the loss may have been 50 per cent. or higher.

There appears to be no evidence of the mongoose destroying rats, and other natural enemies such as snakes and owls are not plentiful.

Even among the people suffering loss many are not sure whether it is the rat or the flying fox which causes the damage. Some say both, others that the flying fox is causing the greater damage. Certainly the flying fox is present in the groves by night, but if it were the real culprit I think one would expect to find the damage more uniformly widespread in the plantations, avoiding the neighbourhood of dwellings; whereas what actually exists is just the opposite to this. Around copra sheds and dwellings the number of nuts on the ground seems greater and, as I stated before, the infected coconut trees seem to occur in groups or colonies. This is more in keeping with the habits of rats, moreover the teeth of the rat are more adapted for the gnawing required to penetrate through the outer husk and shell of the coconut. The flying fox I believe confines its attention to the flowers and on that occasion where a fox was actually seen with its head inside a nut probably a rat had been there previously and made the hole.

When questioned individually on their plantations many of the planters were very apathetic, and took their losses philosophically. A few did not recognise any loss from rats. The majority however were unanimous in their complaints and were greatly concerned about the matter.

Native-owned plantations were seen to be infested as were European-owned plantations. The natives however did not appear to be concerned. Chiefly, I believe, because very few of the Fijian-owned plantations are worked by the owners for what they can produce. Most of them appear to be held by Chinese or others on liens for different periods and these people get what they can out of the plantations while they are in their possession.

The untidy, weed and undergrowth infested condition of most of the plantations favour greatly the continuance and spread of the rat pest, but this matter will be dealt with in the pamphlet on control to be issued.

The meeting of the members of the Vanualevu Progress Association resulted in the following resolutions being made:—

(*a*) that the Agricultural Department be asked to initiate as soon as possible a campaign for the destruction of rats. That the campaign be started at one place in the district and carried on from one end to the other, and at the same time teach the planters how to continue it. That plantation owners are prepared to stand to a proportion of the cost along with the Department;

(*b*) that an Inspector of Plantations be stationed on the southern side of Vanualevu whose duties would be to supervise the rat campaign, general plantations inspection, including control of weeds and other pests. (He might also be given some power to the control of stock);

(*c*) that the Native Department be urged to issue instructions to native officials to co-operate with the departmental officer and settlers in the campaign;

(*d*) that the Department of Agriculture should purchase poisons and other materials necessary for the campaign, and the cost of such purchases to be included in the general cost of the campaign, of which the settlers and, it is hoped, the Native Department will bear a portion;

(*e*) that a pamphlet be issued in English and Fijian by the Agricultural Department on rat control and extermination.

It will be necessary to get a definite assurance from the Vanualevu Progress Association as to the proportion of the cost which the Association is willing to stand up to. The amount that individual plantation owners pay should be based on their total area under coconuts.

I have not made any reference to the means to be employed to control the rat. That will be dealt with in the pamphlet which I will bring out as soon as possible.

The points to be decided now are:—

(*a*) whether the Department will inaugurate a campaign;
(*b*) whether a Plantation Inspector can be sent to Vanualevu for a sufficient period;
(*c*) whether the Government will provide the necessary funds;
(*d*) whether the Native Department will co-operate.

There is no doubt but that rats are a bad plantation pest on Vanualevu and that some organised attempt should be made to combat them.

SHEEP IN FIJI.

By A. Despeissis, M.R.A.C., Acting Superintendent of Agriculture.

The tropics suffer in comparison with the zone called the temperate for sheep farming. The chief disabilities are generally a rank growth of grass and herbage, or the reverse, a scarcity of feed, at times dry and insufficient, also a greater activity of internal or of external parasites. Other factors as well combine to make sheep less profitable in the tropics, but in many cases the unfavourable condition are capable of being remedied or success may be attained by the selection of the right breed to suit particular conditions.

In Fiji sheep farming has not yet received the attention it deserves. In the early days of the Cession to Great Britain, fifty years or thereabouts, Mr. Wilkinson brought a flock of sheep into the Colony and, about sixteen years ago, Mr. H. H. Darcy strengthened that flock, bringing from New Zealand a few hundred sheep.

The progency, consisting at present of a small flock of about forty sheep, are now on Mr. Edwards' property near Nabouwalu on Vanualevu. Referring to these sheep Mr. Edwards remarks that:—

The way sheep thrive and do in this province is no longer a matter of experiment. The wool for years past has brought high prices; fat sheep and lambs sell readily to the butchers at £2 per head.

When the Bua cattle estate was taken over by us (Edwards and Hall) early in 1912, there were about 1,000 sheep running on the property in an almost unattended state. Grazing over roughly 15,000 acres of scrub-covered and unimproved land, with practically no attempt at fencing them or controlling them in any way and no cleared land whatever.

The country was surrounded by native towns with uncontrolled dogs and wild pigs everywhere, these doing endless damage to the sheep. It was obvious to us, as it would be to any sheep man, that it would be impossible to make a commercial success of sheep kept under these conditions, hence the main flock was disposed of, retaining just a few so as to have an opportunity to watch them closely over a period of years. Last year the few I have brought me in a profit of £1 per head for the year.

The photograph accompanying these notes, taken by Mr. MacFarlane, gives a good idea of what these sheep look like to-day, after years of inbreeding. The carcase is on the light side, and the sheep have a dominent strain of Romney Marsh with a small trace of Merino.

Contrary to the opinion one often hears expressed that sheep suffer much from foot-rot in Fiji, these sheep on the undulating pastures of the Bua province have not shown any serious tendency in that direction.

They are grazing on second class land, undulating and in places hilly, consisting of open reed grass country (*Eulalia japonica* - Fijian, " Ga Gasau ") with ferns on the poorer parts. Reed grass and ferns have been partly crushed out with cattle, and shorter grasses, notably Carpet Grass (*Paspalum compressus*) and *desmodium* clovers, are spreading and establishing themselves over the land; on these the sheep thrive well.

With good vermin proof fences there is no necessity for yarding the sheep at night, this meaning additional labour. The wool becomes dirty through the sheep lying down in dusty or in muddy yards, with the result that the price realised is generally lower that it would be were the sheep to pick their own camping ground out on the pastures.

At the time of my visit, a shorn fleece of a four-tooth ewe with six and a half months' growth of wool was handed to me to be submitted to a wool-classer for a report.

The fleece was duly submitted to Messrs. Dalgety & Co., Sydney, for their opinion. That firm after a careful examination described the wool as fine in quality for this particular class and favours the Romney type and although light in condition is not a good colour.

The opinion is also expressed that " from the wool improvement point of view a Merino ram would be desirable, preferably one showing a fair length of staple, density and plenty of yolk, which would improve the fleece considerably, giving more character."

Experiments for the purpose of establishing comparisons, to ascertain which is the best class of sheep for conditions offering in Fiji, have never been carried out and this profitable branch of animal husbandary has not received the attention it deserves.

In spite of the fact that these sheep have been allowed to run and breed without restraint, last year's wool returns for twenty-two sheep and four lambs, averaging four pounds of wool each, brought in a gross return of 8s. 7d. per sheep, the charges amounting to 1s. 6d. each, the wool selling at 25d. per pound. I could not obtain definite information as to the dates between the last and the previous year's shearing.

Another sheep farming venture is reported to have been launched at Sigatoka on the Nadroga coast of Vitilevu some twenty years ago by an Australian grazier, Mr. Percy P. Wright. The Fijians and the Indians are said to have to some extent been a cause of annoyance, but this cannot be said to indicate that sheep farming cannot be profitably carried out in Fiji. Disciplinary measures applied with a firm hand in the case of interference with grazing stock, combined with dog-proof fences, should soon put down sheep killing and give to stock owners the protection they can expect.

That sheep grazing can be successful in the Colony is demonstrated by Messrs. Foulis and Marsh of Wainivoce, who for several years have run a flock on the mountain slopes along the road leading from Tavua to Nadarivatu.

A general view of the type of country run is given in the illustration in this issue. The sheep, which are largely a cross Merino-Romney Marsh, are being gradually improved by culling and breeding as regards both fleece and carcase.

A RETURNED SAILORS AND SOLDIERS DAIRY FARM, TAILEVU.

JERSEY COWS, FIJI PASTORAL COMPANY, NAVUA.

TPYPICAL GRAZING COUNTRY ON THE LEEWARD OF THE ISLAND.

FLOCK OF SHEEP: MERINO–ROMNEY MARSH CROSS, VANUALEVU.

The following extract from the *Auckland Weekly News* of March 5 is interesting:—

Merino wool from Fiji, under the brand of Umbrella/F and M/Fiji, was offered for the first time in London at the beginning of October, and realised the following prices: 3 bales at 25d., 1 bale at 24d., mixed pieces 18½d., second pieces 13½d. The wool contained a large amount of vegetable matter, but was in good condition, with a sprinkling quality of a good 60's.

In the Solomons, 300 miles nearly due west of Fiji, Mr. S. O. Martin has achieved success with sheep at Dillon's Bay on the island of Erromanga. In a letter conveying some interesting information on his venture Mr. Martin gives his experience with Merinos, practically pure:—

The sheep all round would cut about 7½ pounds, including ewes up to ten and twelve years, also did wethers. There is practically no market for butchering sheep.

Lambing would average 60 per cent., but I hope to do better since erecting a fence to keep pigs out of the lambing paddocks; they are responsible for the loss of a number of lambs. The rainfall is much the same as in the dry zone of Fiji, averaging 70 inches with a season of heavy summer rains from November to April and one of lesser rainfall from May to October.

Several of the grasses are useful fodder plants; a burr occurs which gives considerable trouble to keep under; there are probably poison plants, but very few deaths occur. Amongst the pests, blow flies, worms, and lice are more in evidence. I dip for the lice and it also helps with the blow fly. The fly trouble here practically amounts to nothing compared with the mainland of Australia. Last year's clip, sold at first sales in January this year (1924), went up to 32½d, so it is evidently quite possible to grow a decent wool in the islands. It averaged slightly over 24d. all round.

The extracts of this letter given in full show that under very similar conditions to those met with in Fiji, sheep men with experience may expect to meet with success. The conditions of land tenure are leasehold on long terms, twenty-one years and over, so that the capital available need not be sunk into the purchase of freehold land but rather spent in developmental work.

Unlike Erromanga where fat sheep are unsaleable, Fiji offers a good market for mutton which is scarce and dear and which is all inported in small quantities on the hoof or in cold storage and sells at a price which makes it prohibitive to those with a small income. Apart from the European population in the towns and around the sugar mills, mutton, if available, would find a ready sale amongst many well-to-do Hindus for whom it is the favourite meat. Mutton more than wool is the objective and for that reason the Romney Marsh or a strong strain of that breed have proved suited to local conditions.

Sheep are healthy and in the dry zone where they would thrive better, the country which opens out in rolling downs, generally well grassed, carries shorter feed than in the wet zone, where growth is too rank for sheep farming. On good pastures not encumbered with guava, lantana and shrubs, sheep thrive and fatten well.

Of all pests, worms are probably the most serious, but these can be counteracted by making available for stock in boxes in open thatched sheds and protected from the weather in the paddocks, a suitable lick consisting mainly of coarse salt, bone meal, sulphate of iron such as one made of: Salt, 15 parts; bone meal (sterilised), 5 parts; sulphate of iron, 1 part; sulphur, 1 part; lime, 1 part; resin (½ Stockholm tar), 1 part.

Water is well distributed almost everywhere, some shelter trees would be of great advantage where the country is quite open.

The islands are free of pests common in Australia and in New Zealand. There are no wild dogs, foxes, hawks, crows, or blowflies.

The average carrying capability of the land is one sheep to the acre unimproved and three sheep a month or two after a fire for keeping down growth, or after grasses and fodder plants have been sown.

The highest shade reading temperature seldom exceeds 95°F. and is generally in the 80's in the summer. In winter, noon-day heat is about 75°F. and night 55°F. Thus there is growth all the year round and practically no time when lighter stocking is imperative.

Fencing is not so expensive as may be imagined. All fencing material, iron standards, droppers, wire (both barb and plain), staples, netting—come in duty free.

Posts, Buabua (*Guetterda speciosa*), Vesi (*Afzelia cijuga*), Kukulava (*Wormia biflora*) and others, can be cut and brought along the fencing line by natives at a low cost, and holes for the posts are easily dug. A very useful growing post can be procured in many places and plantations of these are easily made, which quickly grow to post size as the leaves are not edible.

An efficient vermin proof fence round the boundary is an insurance against loss, mainly through the depredations of dogs, pigs, and thieves. Subdivisioned fences can be erected on simpler and cheaper lines.

Fencing posts 9 feet apart (586 to the mile) ensure a rigid fence, but when posts are scarce the distance may be 12 feet apart or 440 to the mile.

They should be 2 feet in the ground and 4 feet 2 inches out. A dog proof fence need not necessarily be something unusually high. The specification should provide for wire netting—rabbit proof or a wider mesh—6 inches in the ground and 3 feet out of the ground. Barb wire 5 inches over the netting, plain wire 4 inches higher and a second barb 5 inches over the plain wire or a total of 4 feet 2 inches. Where pigs are bad, a barb close to the ground will prevent them lifting it up from below. As dogs do not jump over the top barb wire but will get through over the netting if the wires are slack, it is advisable to brace the top of the netting and the wires with a thinner wire, say No. 16, three braces to each panel. The bracing wire is first cut into the required lengths and held in bundles. One end is securely fastened to the top of the netting; it is then given a turn round the barb and the plain wire, and then secured to the barb on top. This gives a rigid fence, which no dog will get through, provided always that gates be also made dog proof and that gullies and water courses be protected, as dogs looking for a gap in the fence will follow it for some length. Traps and poisoned baits set outside deal with many of the prowlers. Even with the best of fence, however, vigilance must be the watchword of the successful sheep farmer.

The best method of conducting sheep farming in Fiji is yet one to be demonstrated by practice and it is quite probable that the English and the New Zealand methods of sheep farming in conjunction with root or grazing crops and running on natural pastures would prove more advantageous than the general Australian practice.

ROMNEY MARSH SHEEP.

In New Zealand, Romney Marsh was not chosen for the quality of the wool or for the quality of the mutton. The breed did not come into prominence until it was realised that its hardiness of constitution enabled it to thrive where the sheep of the other British long-wooled breeds failed.

The sheep of this breed are hardy; they survive when other sheep perish; they provide a fair quality of mutton; the ewes are excellent mothers; the lamb of the Romney-Down cross is in demand for exportation and the Romney cross-bred wool sells at a very satisfactory price.

To-day the Romney is the dominant breed of the sheep of the Dominion.

THE RYLAND SHEEP.

THERE are a few flocks in New Zealand. The home of the breed is Herefordshire. It claimed to produce the finest wool of the British breeds. An average wether fleece, 7½ lb.

The cross-bred Ryland is in good favour with the butcher and the lamb is prized for exportation. It is called the white faced Down and its characteristics are: its symmetry, early maturity, hardiness of condition, quality of its meat, fineness of its wool, with a top knot on the forehead. The sheep is said to possess hard hoof and to be little subject to foot rot.

They are in esteem both as a sheep to use for crossing for fat lambs purposes and to use with Romneys to improve the carcase and the quality of the wool.

HONEY IN FIJI.

THE following from the *Fiji Times and Herald*:—

To the Editor,—

Sir,—The article in your issue of the 7th February on honey in tropical countries tempts me to give the results obtained by my bees here in Suva.

From three hives containing bees reared from an Italian queen, imported from New Zealand, I have from the beginning of September to the end of December last, taken 49 square blocks (sections), each containing one pound of honey, in the comb, and 149 lb of extracted honey, and all this was collected out of the recognised honey season.

Two hives of the local black bees, working under exactly the same conditions, gave me no honey at all.

This shows that, provided the right kind of bees are kept, they will be profitable in Fiji, and one colony of bees on an estate would more than keep the homestead in the best of honey all the year round.

The honey in flavour and appearance is excellent, as you can judge from the sample herewith.—I am, &c.,—H. D WALCOT.

The importation of honey is not considerable and amounted last year to 5,276 lb, worth £217, or, say, 10d. per lb. It is nearly all imported from Australia and New Zealand. With the floral wealth for which it is famed, Fiji should be an exporter of honey and of bee's wax.

RECENT LEGISLATION AFFECTING AGRICULTURAL AND PASTORAL INDUSTRIES.

DISEASES OF PLANTS ORDINANCE 1913.

THE following regulations, &c., have recently been made under the provisions of the Diseases of Plants Ordinance 1913, or under regulations made thereunder:—

(1) Regulation 20*a*, was repealed and replaced by a new regulation giving His Excellency the Governor power to order the destruction, or disposal, or treatment, as an Inspector shall think fit, of trees or plants which, in the opinion of an Inspector of Plantations, are affected or are in danger of becoming affected with a declared disease of plants. *Royal Gazette*, No. 21 of 1924, page 119.

(2) *Levuana iridescens* was declared a disease of plants and the islands of Ovalau, Moturiki, Leleuvia, Caqalai, Naigani, Beqa, Yamuca, Malolo, Vitilevu, and the small islands within three miles of the coast of each of such islands were declared as infected. His Excellency the Acting Governor ordered that trees which, in the opinion of an Inspector, are affected or in danger of becoming affected, be destroyed or disposed of or treated as pro-

vided by Regulation 20*a*, referred to in (1) above.—*Royal Gazette*, No. 21, of 1924, page 119 and *Royal Gazette*, No. 44 of 1924, page 215.

(3) Regulations made in 1919 to compel the inspection of vessels proceeding from areas infected with coconut scale to clean areas were repealed and replaced by similar regulations with a view to controlling the spread of *Levuana iridescens*.—*Royal Gazette*, No. 41 of 1924, page 200. The Ports of Suva, Levuka, and Lautoka were declared ports of inspection under these regulations.—*Royal Gazette*, No. 41 of 1924, page 201. The Port of Levuka was closed from the 27th October to the 12th November, 1924, while the destruction of coconut trees at the port, affected with *Levuana iridescens*, was carried out.—*Royal Gazette*, No. 48 of 1924, page 229 and *Royal Gazette*, No. 52 of 1924, page 245.

(4) A proviso to regulation 24 made in 1923 was repealed and replaced by a proviso allowing the holds of vessels containing copra and/or bananas the produce of and loaded in the Kingdom of Tonga to be opened during the stay of vessels in Fiji, in daylight hours only, provided that the produce is accompanied by certificates signed by H.B.M.'s Consul and Agent at Tonga declaring that all ports of that Kingdom except Keppel Island are free from the Rhinoceros Beetle and that there is no communication between Keppel Island and other parts of Tonga except under Government control. —*Royal Gazette*, No. 10 of 1924, page 73.

(5) The 31st October, 1924, was fixed, by notice, as the date prior to which all cotton plants were to be uprooted and destroyed by fire and the 15th November, 1924, as the date prior to which no seed was to be planted.

(6) By notice the following additional areas were declared as infected with the Banana Beetle Borer (*Cosmopolites sordidus*): the islands of Vanualevu, Koro, Ovalau, Nairai, Gau, Kadavu, and Beqa.—*Royal Gazette*, No. 3 of 1925, page 12.

(7) By Order in Council His Excellency the Acting Governor prohibited the importation of pineapples, sugar-cane, and coconuts or portions thereof which have not undergone some process of manufacture or which have not been so throughly dried or cured that they will not grow or germinate if planted, except under a written permit to be issued only under certain conditions by the Superintendent of Agriculture.—*Royal Gazette*, No. 4 of 1925, page 17.

(8) By notices the disease *Thielaviopsis paradoxa*, affecting pineapples, sugar-cane and cocnuts, was declared a disease in the province of Rewa, excluding the island of Beqa, that portion of the province of Naitasiri which lies south of the Waimanu River and the island of Taveuni.—*Royal Gazette*, No. 4 of 1925, page 17, and *Royal Gazette*, No. 9 of 1925, page 33. The removal of certain parts of pineapples, sugar-cane, and the coconuts from land within the areas declared as infected is permitted under certain conditions.—*Royal Gazette*, No. 9 of 1925, page 32.

(9) By notices Sigatoka disease of bananas was declared a disease on the islands of Vitilevu and Ovalau and the small islands within three miles of the coast of each of such islands.—*Royal Gazette*, No. 16 of 1925, page 68. The removal of banana fruit from land within the affected area for local sale or for export to any country except Australia is permitted.—*Royal Gazette*, No. 16 of 1925, page 68.

CONTAGIOUS DISEASES (ANIMALS) ORDINANCE 1907.

Regulations made under this Ordinance empower an Inspector to order the mustering of stock for inspection.—*Royal Gazette*, No. 43 of 24, page 211.

MEAT CANNING.

Cattle raising in the islands only awaits an outlet to become a profitable undertaking; for lack of a market it is now languishing. Thousands of head of cattle once seen grazing in coconut groves and in keeping down grass growth are allowed to stray and have now run wild. At the same time large quantities of canned meat is imported, valued for Customs entry at £23,000 on a five years' average.

The question of establishing a meat canning factory which has long been discussed is at last approaching realisation. Steps are being taken by the Hon. Mr. Henry Marks for the erection of a proprietary cannery, capable of putting through 2,000 head of cattle a year, on his Tova Estate at Vitilevu Bay. The cattle are on the pastures, the plans are ready and the details of the scheme are now nearing finality.

The planters of Taveuni and adjacent islands would no doubt readily support another factory on that island which at present carries over 4,500 head irrespective of mobs of wild cattle away on the ranges above the coconut plantations. With the outlet created by such a factory the present number could be greatly increased, provided a paying price was assured for fats and forward stores at the factory.

The export of cattle to Australia is not permitted, but a market is here within the grazier's reach. What has been practically demonstrated as a feasible proposition in the case of butter factories can be with equal promise of success be made to apply to meat factories. A co-operative movement prepared to put up an up-to-date factory efficiently managed, established in the midst of the pastures, should prove a commercially attractive undertaking.

EXPORT OF BANANAS TO AUSTRALIA.

The following circular has been issued for public information to the Inspector of Produce and all officers connected with the handling of produce for export.

His Excellency the Acting Governor has been informed by telegram that the Commonwealth Authorities have prohibited the importation into Australia of bananas, plants, and fruit from Fiji unless accompanied by an official certificate signed by a responsible officer of this Government stating that they were grown on areas declared by the Government Expert to be free from Sigatoka disease.

Sigatoka disease has been declared a disease under the Diseases of Plants Ordinance 1913, and the Islands of Vitilevu and Ovalau defined as infected areas (*Royal Gazette* No. 16 of 1925, page 68). His Excellency has permitted the removal of fruit from plantations in the defined areas for local sale or for export to any country except Australia (*Royal Gazette* No. 16 of 1925, page 68).

Certificates as required by the Australian Government are not to be issued for the export of bananas *from any area in the Colony* unless you have first received written advice from this office that such areas gave been inspected by the Government Mycologist and declared by him to be free of the disease.

MARKET RATES.

(London, December, 1924.)

Butter	198/- to	200/-	per cwt.
Cheese	94/- ,,	96/-	,,
Tallow (Beef)	49/- ,,	52/-	,,
Tallow (Mutton)	50/- ,,	60/-	,,
Sheepskin	15d. ,,	30d.	per lb.
Cacao	30/- ,,	85/-	per cwt.
Coffee	108/- ,,	162/-	,,
Copra	29/- ,,	32/-	,,
Coconut (Dessicated)	38/- ,,	39/-	,,
Cotton (Middling American)	15/- ,,	16/-	per lb.
Cotton Seed	12/6 ,,	13/6	per cwt.
Castor Beans (Bombay)	25/- ,,	28/-	,,
Honey (Light Amber)	75/- ,,	87/-	,,
Honey (White)	88/- ,,	92/-	,,
Linseed	21/- ,,	24/-	,,
Peanuts (Hull)	25/- ,,	27/-	,,
Soya Beans	12/- ,,	13/-	,,
Oils—			
Citrus Products—			
Distilled Lime Oil	5/- ,,	5/3	per lb.
Hand Pressed		8d.	,,
Orange Oil		8/6	,,
Castor Oil (First)		£70	per ton
Coconut Oil	£48 ,,	£62	,,
Cotton Seed (Crude)	£46 ,,	£47	,,
Peanut (Ground Nut)	£50 ,,	£57	,,
Linseed	£45 ,,	£48	,,
Soya Bean	£45 ,,	£47	,,
Oil Cake—			
Cotton Seed		8/-	per cwt.
Coconut		9/-	,,
Castor Bean		13/-	,,
Linseed		14/-	,,
Peanut (Decorticated)		13/-	,,
Rice (Rangoon)	300/- ,,	310/-	per ton.
Rubber		17d.	per lb.
Tea (Java)		18¾d.	,,
Tea (Ceylon)		23d.	,,
Manila Hemp		£57	per ton.
Sisal Hemp		£49	,,

AUCKLAND PRICES OF PRODUCE DURING 1924.

Month.	Bananas.	Pineapples.	Tomatoes.	Kumalas.	Watermelons.	Mandarins.	Cucumbers.	Pumpkins.	Maize.	Remarks
	Max.–Min.	Max.–Min.	Max.–Min.	Max.–Min.	Max.–Min.	Max.–Min.	Max.–Min.	Max.–Min.	Max.–Min.	
Jan. 26	18/- — 16/-	20/- — 15/-	....	....	....	....	....	....	....	Bananas good condition; Cayenne pines too green and badly fumigated.
Feb. 23	18/- — 4/-	....	....	....	....	....	....	....	....	Bananas mixed condition and too many over-ripe.
Mar. 20	18/- — 1/-	....	....	....	....	13/- aver.	....	....	....	Bananas bad condition; mandarins too green.
April 4	22/- aver.	....	....	....	....	13/- aver.	....	....	....	Bananas good condition; mandarins also good.
April 17	12/- — 2/6	....	....	....	....	....	....	....	....	Bananas bad condition.
May 10	19/- — 18/-	....	....	....	....	10/- aver.	....	....	....	Bananas good condition; mandarins also good.
June 4	17/- aver.	....	....	....	....	....	....	....	....	Bananas in good condition.
July 1	16/- — 7/-	....	....	16/- — 12/-	....	....	9/6 aver.	....	....	Bananas, kumalas, and cucumbers in good condition.
July 30	22/- aver.	....	....	15/6 — 9/-	....	....	9/- aver.	....	....	Bananas, kumalas, and cucumbers in good condition.
Aug. 27	21/- — 20/-	....	20/- — 13/6	12/- — 10/-	....	....	11/- — 8/-	....	....	Bananas, kumalas, and cucumbers in good condition.
Sept. 26	24/- — 21/6	....	10/6 aver.	15/- aver.	....	....	....	....	....	Bananas good; tomatoes fair, rather small; kumalas 163 sacks condemned for weevil, balance good.
Oct. 29	23/- — 18/-	14/- — 13/-	15/- — 13/-	15/- — 12/-	....	....	9/6 aver.	....	....	Bananas, tomatoes, kumalas, cucumbers good; pines badly fumigated, mealy bug alive.
Nov. 28	22/- — 19/-	17/6 — 14/-	7/- — 5/-	Not known	....	....	2/6 aver.	....	3/9 bus. f.o.b.	Bananas good; tomatoes market glutted; cucumbers over-ripe; pines badly fumigated, mealy bug all alive; maize infected with moth.
Dec. 13	19/- — 14/-	16/- — 13/-	....	Not known	2/- aver.	....	....	2/6 aver.	....	Bananas, melons, kumalas, and pumpkins good; pines badly fumigated, mealy bug alive.
Dec. 24	18/- aver.	10/- aver.	....	Not known	2/- aver.	....	....	1/10—1/5	3/9 bus. f.o.b.	Bananas and watermelons in good condition; pines good and well fumigated, mealy bug all dead; maize not mentioned.

Sizes of packages.—Banana cases, 36″ by 12″ by 10″; pineapple cases, 36″ by 12″ by 10″; tomato cases, 30″ by 7″ by 5″; citrus cases, 26″ by 14¼″ by 6″; all external measurements. Kumalas (in sacks), average weight about 140 lb; potatoes (in bags), average weight about 112 lb.

N.B.—Coconuts prohibited unless Quarantine Regulations are complied with (fruit fly).

ACTUAL AND AVERAGE RAINFALL FOR THE MONTHS JUNE—DECEMBER, 1924.

Province.	Station.	Observer.	No. of years.	June.		July.		August.		September.		October.		November.		December.		Annual average rainfall to end 1924
				Actl.	Aver.	Actl.	Aver.	Actl.	Aver.	Actl.	Aver.	Actl.	Aver.	Actl.	Aver.	Actl.	Aver.	
				"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Ba	Narovurovu	District Commr.	3	1·65	3·65	5·04	2·85	2·72	4·73	3·00	3·76	4·25	4·64	9·36	6·35	9·30	8·10	103·85
Ba	Rarawai	C.S.R. Co., Ltd.	30	1·73	2·46	5·18	1·80	3·23	3·20	4·79	2·46	4·28	3·23	7·58	4·90	8·62	9·75	81·62
Bua	Nabouwalu	Roko Tui Bua ..	7	9·27	4·57	12·54	4·92	8·10	4·76	7·76	5·14	8·84	6·15	11·43	8·60	..	..	..
Bua	Wainunu.....	S. E. Martin	45	11·45	6·45	13·80	5·72	10·80	6·62	8·80	9·22	7·10	10·68	18·75	12·10	13·52	16·41	149·28
Cakaud'e..	Buca Bay	W. C. Fisher ...	12	14·48	5·63	8·48	3·70	5·60	3·82	3·95	4·16	2·90	4·46	10·65	8·35	6·83	13·92	95·72
Cakaud'e..	Rabi	P. J. Lyons	20	23·61	7·70	6·43	4·74	8·98	6·87	5·50	7·78	4·77	8·68	16·69	11·15	7·66	18·30	147·13
Cakaud'e..	Savusavu Bay ..	Wireless Station.	18	11·81	5·52	15·46	1·84	8·63	6·19	5·60	6·89	5·59	7·85	8·83	8·03	12·92	12·90	103·92
Cakaud'e..	Vuna, Taveuni .	Tarte Bros.	5	25·66	7·49	18·05	7·13	17·52	8·46	14·30	10·24	11·70	10·31	19·40	9·30	6·53	16·20	133·88
Cakaud'e..	Waiyevo	Wireless Station.	18	22·83	5·61	5·62	2·42	8·73	3·59	3·61	5·51	3·37	7·31	22·10	9·33	6·87	12·22	101·18
Colo North	Nadarivatu.....	District Commr.	24	2·62	3·04	4·92	3·40	6·69	5·60	3·97	4·03	6·81	4·66	10·80	8·05	38·31	16·06	129·63
Colo North	Tavua	C.S.R. Co., Ltd.	18	1·13	2·10	5·31	1·50	2·56	2·97	5·29	2·30	4·84	2·66	3·03	4·06	10·35	8·60	71·89
Lau	Nabavatu	K. J. Allardyce .	5	4·82	2·67	3·23	2·81	17·27	5·06	6·71	4·91	4·48	4·10	4·81	4·46	6·82	10·23	77·60
Lautoka ..	Lautoka	C.S.R. Co., Ltd.	24	1·85	2·15	3·70	1·95	2·31	3·60	4·06	2·06	4·89	3·24	9·43	4·21	8·94	7·81	68·95
Lomaiviti .	Levuka	Harbour Master	30	14·80	4·71	8·82	3·80	13·64	5·60	3·13	5·04	7·58	5·18	5·43	8·31	13·68	9·30	92·19
Lomaiviti	Makogai	Res. Med. Supt.	13	9·30	3·88	8·34	4·97	6·54	3·93	2·24	5·64	9·41	4·31	6·88	6·01	10·51	10·72	81·63
Nadi	Navo No. 2	C.S.R. Co., Ltd.	23	3·08	2·11	1·77	2·01	2·42	3·65	4·12	2·20	4·02	2·85	9·87	3·96	9·10	7·80	64·20
Nadroga ..	Lawaqa	District Commr.	18	1·33	3·50	2·37	2·64	2·09	5·64	7·35	3·05	2·76	3·73	5·08	5·16	6·03	7·60	70·25
Rewa	Suva	Supt. of Agric. ..	40	25·15	6·50	5·10	4·79	27·08	7·83	16·84	8·31	12·55	8·77	9·19	9·96	10·13	12·65	120·05
Serua	Navua (Nai'toni)	District Commr.	8	25·35	9·85	3·52	6·36	27·46	11·09	15·12	9·11	25·25	10·51	16·88	15·30	6·12	13·61	138·23
Tailevu ...	Nausori	C.S.R. Co., Ltd.	30	20·07	6·45	5·73	4·50	25·69	7·36	6·02	6·44	8·68	7·44	8·35	9·15	9·08	13·34	114·47
Tailevu ...	Wainivesi	C. A. Ross	2	27·11	16·64	13·16	8·91	28·99	18·22	32·71	19·96	19·45	18·02	11·93	18·62	4·88	8·52	185·16
Ra	Burenitu	T. Coster	6	5·10	3·84	5·59	3·33	11·57	5·00	3·30	5·39	6·06	3·90	5·05	8·61	8·53	12·35	104·58
Lekutu ...	Delanasau.....	L. N. Anderson .	42	..	2·12	..	1·80	..	2·22	..	2·98	..	4·91	..	5·36	..	9·18	91·00
Macuata ..	Labasa	C.S.R. Co., Ltd.	30	4·10	2·30	3·14	19·08	1·83	1·71	2·64	2·63	2·86	3·13	10·75	5·30	13·80	10·54	98·32
Cakaud'e..	Natuvatu	F. B. Spaeth ...	8	21·85	5·57	11·18	4·66	11·44	6·46	11·20	7·56	6·27	8·91	9·69	10·72	7·66	13·23	121·66

J. H. Spaeth, Savusavu West, submits the rainfall taken at that station. The average rainfall at the Wireless Station, at the District Commissioner's headquarters on the eastern side of the Bay, is much less than Savusavu West.

To the west of this station the fall increases until Wainunu is reached, when the actual fall is about the maximum for the windward side of Vanualevu and then gradually decreases until Nabouwalu at the south-western point of the island is reached and then again progressively decreases through to Dama, which is practically the end of the wet zone, as from Dama to Dreketi and the Macuata coasts the country which is on the lea side of the mountain axis running through the island is in the dry zone.

The season on the Bua and Macuata coasts are very marked. Mr. Spaeth registered the rainfall at Dreketi for about eleven years and the average fall was about 80 inches. Mr. R. L. Holmes took meteorological observations for a number of years at Lekutu, a work continued uninterruptedly by Mr. L. N. Anderson and the Colonial Sugar Refining Company, Limited, have registered the fall at Labasa for about thirty years so that we have the records now for most of the island of Vanualevu.

DEPARTMENT OF AGRICULTURE.

LIST OF STAFF.

Superintendent of Agriculture	Hon. A. Despeissis, M.R.A.C. (Acting)
Editor of Agricultural Circular	Do.
Government Veterinary Officer	C. R. Turbet, B.V.Sc., Sydney.
Government Mycologist	J. G. C. Campbell, B.Sc.
Government Chemist	Colin L. Southall, B.Sc., A.I.C.
Government Entomologist	H. W. Simmonds, F.E.S. (Acting).
Cotton Inspector	B. Lyon Field, A.M.I.E., India.
Inspector of Produce	E. S. Gordon.
Inspector of Plantations	G. H. V. Saunders.
Do.	C. T. McNamara.
Do.	M. A. Forsyth.
Do.	J. White (Temporary).
Inspector of Plants (Lautoka)	R. H. Phillips.
Do. (Levuka)	Capt. E. F. Wallack.
Do. (Rotuma)	C. Jacobsen.
Inspector of Stock (Suva)	E. S. Gordon.
Do. (Suva)	W. T. C. Edwards.
Do. (Lautoka)	R. H. Phillips.
Do. (Levuka)	A. P. Michel.
Manager, Government Rice Mill	J. P. Tarby.
Chief Clerk	A. B. Ackland.
Clerk and Typiste	Miss M. H. Riley (Temporary).
Clerk	G. G. Lenox.
Fifth Class Clerk	Rafaele Kurusiga.
Messenger	Bila Jione.

INDEX—January–June, 1925.

A

PAGE

Agricultural School, Navuso 7
Auckland Prices of Produce during 1924 107

B

Bananas to Australia—Export of 105
Banana Beetle Borer (*Cosmopolites sordidus*) 88
Banana Diseases in Vitilevu, *by J. G. C. Campbell* 67
Banana Scab Moth 75
Banana—Robusta.. 77
Burdizzo Castrator 94
British Cotton Growing Association and Fiji Cotton 41
Butter Fat Average 14

C

Cattle Dip 96
Cattle Importation 96
Copra—Drying and Baling 46
Copra—Samoan 5
Cotton Cultivation 16
Cotton—Danger of Hybridising 43
Cotton—Fiji 39
Cotton—Fiji—in England 38
Cotton Industry 38
Cotton—Meade 44
Cotton Picking Machine 44
Cotton Cultivation in Fiji—Possibilities of Extending, *by G. Evans* 19
Cotton—Second Sale of Fiji Cotton 41
Cotton Spinners' Advice 42
Cut Worm Pest (*Prodenia litura F.*), *by H. W. Simmonds* 86
Current Issue 1

D

Dairying by Natives 12
Dairy Cow's Rations, *by A. Despeissis* 14
Department of Agriculture—List of Staff 109
Department of Agriculture, Raboul 1
Desmodiums—Tropical Clovers 9

E

Erratum 1

F

Fiji Cotton.. 39
Fiji Cotton in England 38
Fiji Sores 95
Fruits—Preserving Tropical 4

G

PAGE

Government Chemist 1
Grammar School Test Plots 2
Grasses—Analysis of 13
Grass—Carpet (*Axonopus compressus*) 12
Grass—Elephant 11
Grass—Kikuyu 11
Grass—Russell River 10
Grasses for the Sigatoka Valley 11
Grass—Sour Paspalum 5
Grass Seeds 8

H

Honey in Fiji 103
House Fly Pest and its Control in Fiji, *by H. W. Simmonds* .. 85

I

Index 110, 111, 112
Insectivorus Bats 88
Insectivorus Birds 2

K

Kava or Yaqona, *by A. Despeissis* 64
Kumala or Sweet Potato Weevil (*Cylas formicarius*) 87

L

Legislation affecting Agricultural and Pastoral Industries 103
Levuana Iridescens, *by J. D. Tothill* 83

M

Mange—Demodectic 92
Manges of Dogs in Fiji 89
Market Rates 106
Mate or Paraguay Tea 67
Mauritius Beans 79
Meat Canning 105
Meteorological Returns 108
Mosquitoes—Combating 3

N

Noxious Weeds 7

O

Oil Production and Castor Bean 81
Overgrown Hoofs 91

P

Peanuts, *by A. Despeissis*.. 59
Pineapple for Canning, *by A. Despeissis* 49
Pineapple Experimental Plantation, Tova Estate, Vitilevu Bay—Soils from 58
Pineapple Growing and Canning Industry 54
Pineapples for Vancouver 57

R

PAGE

Rats and Coconuts, *by C. R. Turbet* 97
Rice Experimental Plots 3
Robusta Banana 77
Romney Marsh Sheep 102
Ryland Sheep 103
Rotuma—The Island of, *by M. A. Forsyth* 47

S

Samoan Copra 5
Sheep in Fiji, *by A. Despeissis* 99
Sheep—Romney Marsh 102
Sheep—The Ryland 103
Soil Erosion 2
Soils from Pineapple Experimental Plantation, Tova Estate, Vitilevu Bay 58
Sunflower (Giant Russian), *by R. B. Howard* 77

V

Veterinary Notes, *by C. R. Turbet*—
Manges of Dogs in Fiji 89
Overgrown Hoofs 91
Burdizzo Castrator 94
Worm Infestation of Pigs in Fiji 93
Fiji Sores 95
Demodectic Mange 92

W

Water Hyacinth 6
Worm Infestation of Pigs in Fiji 93

Y

Yaqona or Kava, *by A. Despeissis* 64